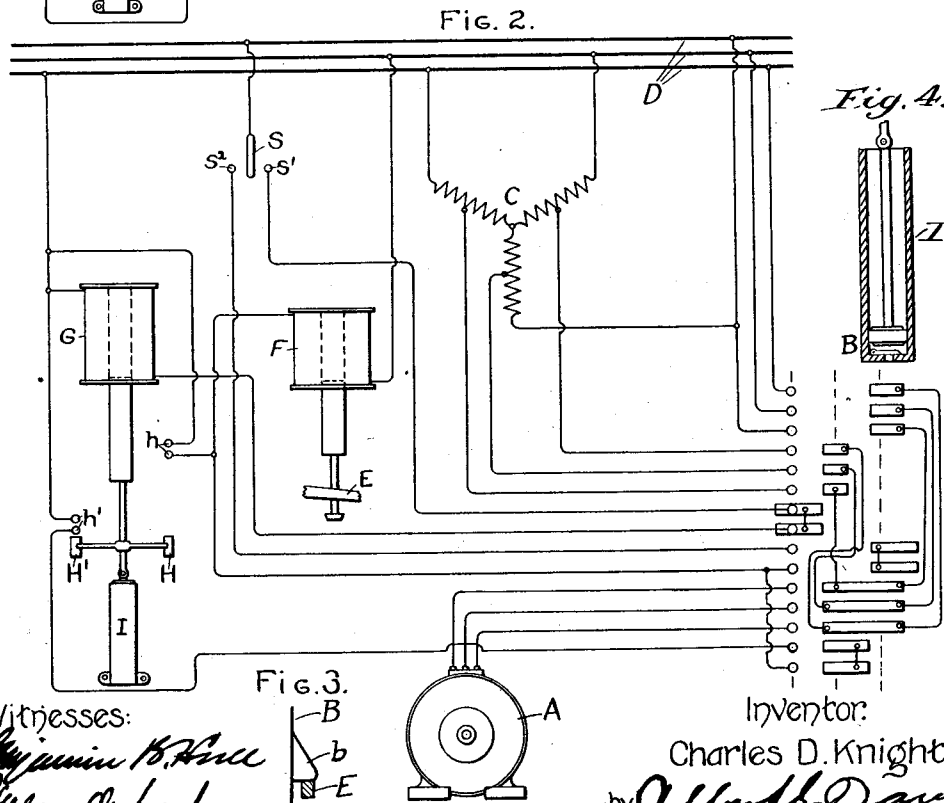
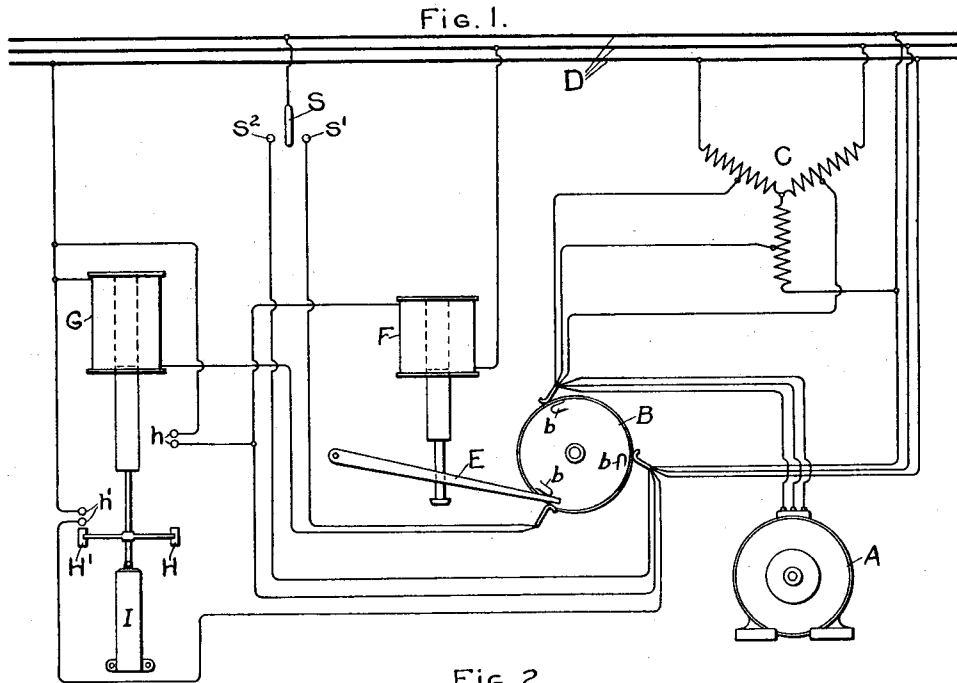


C. D. KNIGHT.
AUTOMATIC STARTING SWITCH.
APPLICATION FILED DEC. 1, 1905.

1,064,228.

Patented June 10, 1913.



Witnesses:

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by *Albert D. Davis*
Att'y.

UNITED STATES PATENT OFFICE.

CHARLES D. KNIGHT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC STARTING-SWITCH.

1,064,228.

Specification of Letters Patent.

Patented June 10, 1913.

Application filed December 1, 1905. Serial No. 289,775.

To all whom it may concern:

Be it known that I, CHARLES D. KNIGHT, 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 Starting-Switches, of which the following is a specification.

My invention relates to starting switches for electric motors, and its object is to provide a novel and efficient apparatus for automatically establishing the proper circuit connections for a motor for starting and for running, with proper time-intervals between the changes in the circuit connections; the apparatus being controlled by a simple switch or contact-maker.

By means of my invention a motor may be properly connected for starting, and when it is up to speed the proper connections for running automatically established; the apparatus being controlled by a simple contact-maker, which may be actuated either manually or automatically,—as, for instance, by a fluid-pressure governor.

My invention is particularly applicable to the control of alternating-current motors, such as induction motors with short-circuited secondary, which are started by lowering the impressed primary voltage, although it is not limited to this particular application.

My invention in one aspect consists in the combination of a switch rotatable continuously in the same direction, and having an off-position and a plurality of operative positions, operating means adapted to move the switch step by step, controlling means adapted when actuated to energize the operating means automatically a predetermined number of times at predetermined intervals, and means for energizing the operating means independently of the controlling means so as to shift the switch from the last operative position to off-position and to bring the motor to rest when desired.

In another aspect my invention consists in the combination of a switch rotatable continuously in the same direction and having an off-position and a plurality of operative positions, and means operative upon the closing of an electric circuit for automatically shifting the switch step by step at predetermined intervals from off-position to its several operative positions, and upon

the closing of a second electric circuit shifting it from the last operative position to off-position.

More specifically stated, my invention consists in the combination of a switch rotatable continuously in the same direction and having an off-position and a plurality of operative positions, an electromagnet for operating said switch, ratchet connections between the switch and controlling magnet, means controlled by the controlling magnet for closing and breaking the circuit of the operating magnet a predetermined number of times at predetermined intervals, and means for closing the circuit of the operating magnet independently of the controlling magnet.

My invention further consists in the combination of an alternating-controlling motor, a voltage-controlling device, a switch adapted to connect the motor in different relations to the device for starting and running, electromagnetic operating means adapted when energized to shift the switch step by step from off to starting and then to running position, and means for retarding the operation of the operating means.

My invention further comprises means for automatically deenergizing the operating means upon the movement of the switch so as to save loss of power, and means for again energizing the operating means to continue the movement of the switch from running to off-position when it is desired to stop the motor.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows diagrammatically a motor provided with automatic starting and controlling apparatus arranged in accordance with my invention; Fig. 2 shows another view of the same with the mechanical connections between the operating means and the switch omitted and with the switch contacts developed on a plane surface; Fig. 3 shows a detail of the connections between the operating magnet and the switch and Fig. 4 is a detail of the dash-pot.

In the drawings, A represents an alternating-current induction-motor which is connected through the controlling switch B to a voltage-controlling device, such as a compensator C, which is supplied from the source of three-phase current indicated by

the line-wires D. At starting the motor is connected to intermediate points on the compensator winding, and in running is connected directly to the line. The switch B is mounted so that it is continuously rotatable in the same direction, and is actuated by a ratchet mechanism consisting of a pivoted bar E, which is raised every time the operating magnet F is energized, and lugs b on the switch which are adapted to be engaged by the pivoted bar E. Every time the bar E is raised it rotates switch B one hundred and twenty degrees. Three lugs b are provided, and are so arranged, as shown in Fig. 3, that the bar E in falling, when released by the operating magnet, slides over and engages the underside of a lug so that it is ready to shift the switch again when the operating magnet is again energized. The operating magnet F is controlled by a controlling magnet G which, when energized, is arranged to close and break the circuit of the operating magnet a predetermined number of times at predetermined intervals. The said number of times corresponds to the number of operative positions of switch B, and in the case shown is consequently two. The closing and breaking of the circuit of magnet F is accomplished by a pair of switch contacts H and H' carried by the core of magnet G which are adapted to engage the contacts h and h' respectively. The desired time-interval is obtained by means of a dash-pot I connected to the core of the controlling magnet G. The controlling magnet is in turn controlled by a master-switch S, which is adapted to engage the contact s' to close one circuit for starting, or to engage the second contact s² to close another circuit for stopping the motor. The switch S may be a simple manually-operated switch, or may be controlled by a fluid-pressure governor or any other automatic device.

The operation of the apparatus above described is as follows: At starting, the switch B is in off-position and the motor circuit is broken as is shown in Fig. 2. To start the motor the switch S is moved into engagement with contact s'. A circuit is then closed through switch S, contact s', contacts carried by switch B, and controlling magnet G. Controlling magnet G is consequently energized and draws up its core. The dash-pot is preferably arranged so as to exert no retarding effect when the core is raised, but only to retard the downward movement of the core. When the core of controlling magnet G reaches its highest position the switch contact H bridges the stationary contact h, thereby closing a circuit through the operating magnet F. This magnet consequently draws up the pivoted bar E and shifts switch B one hundred and twenty degrees, thereby connecting the motor A to inter-

mediate points on the winding of compensator C, as is evident from an inspection of Fig. 2. At the same time, the circuit of controlling magnet G is broken at switch B, and this magnet consequently releases its core, which drops,—retarded by the dash-pot. At the beginning of its downward movement, contact H leaves contacts h, breaking the circuit of operating magnet F and allowing bar E to fall and engage another lug b on the switch B. The downward movement of the core of controlling magnet G continues, and meanwhile the motor A is speeding up. The dash-pot is so proportioned that when the motor reaches the proper speed the switch contact H' bridges the contacts h', thereby again closing the circuit of operating magnet F through a set of contacts on switch B, as shown in Fig. 2. Operating magnet F again raises pivoted bar E, again rotating switch B one hundred and twenty degrees, so as to bring it from starting into running position. The motor is then connected so as to receive the full-line voltage, and at the same time the circuit of operating magnet F is broken at switch B and the pivoted bar E again drops to engage the third lug b. The motor is thus brought from rest up to full speed and proper running connections are established with the proper time-interval between the change in circuit connections. It will also be noticed that when the motor is thus brought up to speed both operating and controlling magnets are out of circuit so that there is no energy wasted in their windings during normal operation.

The motor continues in operation until switch S is moved to engage contact s², so as to close the stopping circuit. This circuit extends from contact s² through a pair of contacts on switch B, which are closed in running position, and through operating magnet F. The operating magnet consequently is again energized and rotates switch B another one hundred and twenty degrees, which brings it from running back to off-position. The motor circuit is thereby broken and the motor stops. At the same time the circuit of operating magnet F is broken at switch B and the pivoted bar E is again allowed to fall. The apparatus is thus once more in the same condition as at starting, and is ready for again starting the motor whenever switch S is moved to close the starting circuit.

For the sake of simplicity I have illustrated my invention somewhat diagrammatically, and it will be understood that in practice any suitable construction of switch and operating and controlling magnets may be employed.

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

1. In combination, a switch rotatable al-

ways in the same direction and having an off-position and a plurality of operative positions, operating means adapted to move said switch step by step, controlling means adapted when actuated to energize said operating means automatically a predetermined number of times at predetermined intervals, and means for energizing said operating means independently of said controlling means.

2. In combination, a switch rotatable always in the same direction and having an off-position and a plurality of operative positions, an electromagnet for operating said switch, ratchet connections between said switch and said magnet, a controlling magnet, means controlled by said controlling magnet for closing and breaking the circuit of said operating magnet a predetermined number of times at predetermined intervals, and means for closing the circuit of the operating magnet independently of the controlling magnet.

3. In combination, a switch rotatable always in the same direction and having an off-position and a plurality of operative positions, an operating magnet, ratchet connections between said switch and said magnet, a controlling magnet, a switch actuated by said controlling magnet and adapted to close and break the circuit of said operating magnet a predetermined number of times, and means for retarding the movement of the last-mentioned switch.

4. In combination, a switch rotatable always in the same direction and having an off-position and a plurality of operative positions, an electromagnet for operating said switch, ratchet connections between said switch and said magnet, a controlling magnet, means controlled by said controlling magnet for closing and breaking the circuit of said operating magnet a predetermined number of times at predetermined intervals, means for closing the circuit of the operating magnet independently of the controlling magnet, and means controlled by the movement of said switch for breaking the circuit of said controlling magnet.

5. In combination, a switch rotatable always in the same direction and having an off-position and a plurality of operative positions, an electromagnet for operating said switch, ratchet connections between said switch and said magnet, a controlling magnet, means controlled by said controlling magnet for closing and breaking the circuit of said operating magnet a predetermined number of times at predetermined intervals, means for closing the circuit of the operating magnet independently of the controlling magnet, and switch contacts carried by said switch in circuit with said controlling magnet.

6. In combination, a controlling switch al-

ways rotatable in the same direction and having off, starting, and running positions, an operating magnet for said switch, ratchet connections between said magnet and said switch, a controlling magnet adapted when energized to make and break the circuit of said operating magnet twice at a predetermined interval, and means for closing the circuit of said operating magnet independently of said controlling magnet.

7. In combination, a controlling switch always rotatable in the same direction and having off, starting, and running positions, an operating magnet for said switch, ratchet connections between said magnet and said switch, a controlling magnet, means actuated by the movement of the core of said controlling magnet when energized for closing the circuit of the operating magnet to move said switch from off to starting position, means for automatically breaking the circuit of the controlling magnet when said switch is moved, means actuated by the movement of the core of the controlling magnet when deenergized for breaking and then again closing the circuit of the operating magnet to shift said switch to running position, means for retarding said movement of said core, and means for closing the circuit of said operating magnet independently of said controlling magnet to shift said switch to off-position.

8. In combination, a controlling switch always rotatable in the same direction and having off, starting and running positions, an operating magnet for said switch, ratchet connections between said magnet and said switch, a controlling magnet, means actuated by the movement of the core of said controlling magnet when energized for closing the circuit of the operating magnet to move said switch from off to starting position, means for automatically breaking the circuit of the controlling magnet when said switch is moved, means actuated by the movement of the core of the controlling magnet when deenergized for breaking and then again closing the circuit of the operating magnet to shift said switch to running position, means for retarding said movement of said core, a switch adapted to close the circuit of said operating magnet independently of said controlling magnet, and means for automatically breaking the circuit of the last-mentioned switch when the motor-controlling switch is moved to off-position.

9. In combination, a controlling switch rotatable always in the same direction and having an off-position and a plurality of operative positions, operating means for said switch, controlling means for automatically energizing said operating means to move said switch step by step at predetermined intervals from off-position to the

several operative positions, and means for energizing said operating means independently of said controlling means to move said switch from the last operative position to off-position.

10. In combination, a controlling switch rotatable always in the same direction and having an off-position and a plurality of operative positions, an operating magnet, ratchet connections between said magnet and said switch, controlling means for automatically energizing said magnet a predetermined number of times corresponding to the number of operative positions of said switch at predetermined intervals, and means for energizing said magnet independently of said controlling means.

11. In combination, a controlling switch having off, starting, and running positions, an operating magnet for said switch, ratchet connections between said magnet and said switch, a controlling magnet, means actuated by the movement of the core of said controlling magnet when energized for closing the circuit of the operating magnet to move said switch from off to starting position, means for automatically breaking the circuit of the controlling magnet when said switch is moved, means actuated by the movement of the core of the controlling magnet when deenergized for breaking and then again closing the circuit of the operating magnet to shift said switch to running

position, and means for retarding said movement of said core.

12. In combination, a switch rotatable always in the same direction and having an off-position and a plurality of operative positions, operating means adapted to move said switch step by step, controlling means adapted when actuated to energize said operating means automatically a predetermined number of times at predetermined intervals, means for energizing said operating means independently of said controlling means, and means for automatically breaking each of said electric circuits when the switch is shifted.

13. In combination, a controlling switch having off, starting and running positions, an electromagnetic controlling device for said switch arranged to close an electric circuit to automatically shift said switch from off to starting position and after a predetermined interval to close another circuit to shift the switch to running position, and means controlled by said electromagnetic device whereby said switch is automatically shifted from running to off position.

In witness whereof, I have hereunto set my hand this 29th day of November, 1905,

CHARLES D. KNIGHT.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

BEST AVAILABLE COPY

Correction in Letters Patent No. 1,064,228.

It is hereby certified that in Letters Patent No. 1,064,228, granted June 10, 1913, upon the application of Charles D. Knight, of Schenectady, New York, for an improvement in "Automatic Starting-Switches," an error appears in the printed specification requiring correction as follows: Page 2, line 115, for the word "if" read *of*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of July, A. D., 1913.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.