

L. A. HAWKINS.
STARTING DEVICE FOR ALTERNATING CURRENT MOTORS.
APPLICATION FILED SEPT. 24, 1907.

1,055,907.

Patented Mar. 11, 1913.

Fig. 1.

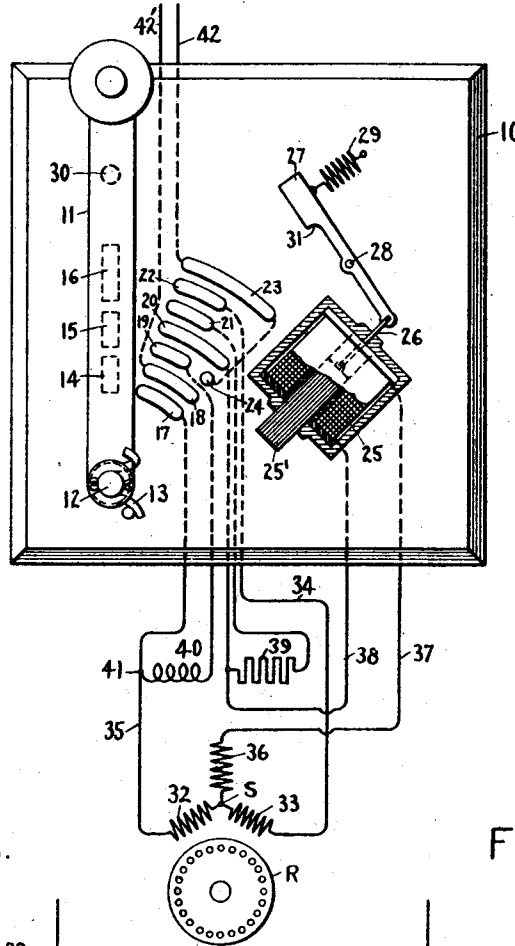


Fig. 2.

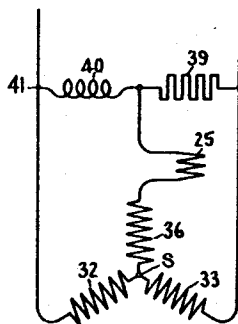
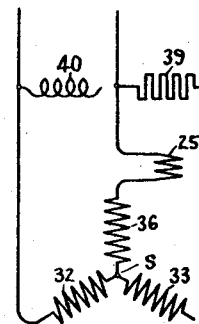


Fig. 3.



Witnesses:
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UNITED STATES PATENT OFFICE.

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STARTING DEVICE FOR ALTERNATING-CURRENT MOTORS.

1,055,907.

Specification of Letters Patent.

Patented Mar. 11, 1913.

Application filed September 24, 1907. Serial No. 394,278.

To all whom it may concern:

Be it known that I, LAURENCE A. HAWKINS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Starting Devices for Alternating-Current Motors, of which the following is a specification.

This invention relates to the control of alternating-current motors, and has for its object, the provision of means whereby motors of this type may be started and brought up to running speed in a reliable and efficient manner.

My invention relates more specifically to the starting of single-phase motors of the induction type. This type of motor, as is well known, will not start from rest without the employment of special starting devices, such as an auxiliary starting winding or a phase-splitting device connected in the motor circuit or both. Devices of this character are designed to be in circuit for only a short period during which the motor is being brought up to synchronism and if left in circuit too long, will become overheated. Means have therefore been employed for changing the connections so as to cut out this starting device.

The object of my invention is to provide, in connection with a device for changing the connections, means whereby the circuit-changing switch cannot be moved to running position until the motor has been brought up to the proper running speed.

I also provide means whereby the switch is held in running position, and automatically returned to the off position upon the failure of voltage.

In the accompanying drawings, in which I have shown my invention embodied in concrete mechanism, Figure 1 is a plan view of the device showing circuit connections, and Figs. 2 and 3 show respectively the circuit connections of the motor for starting and running.

Referring to the drawing 10 is an insulating base of slate or soapstone having mounted thereon a controlling arm 11 pivoted at 12, and biased to the off position shown in the drawings by means of the spring 13. This arm is provided with contacts 14, 15 and 16 insulated from the arm and cooperating with a series of the contact segments

17, 18, 19, 20, 21, 22 and 23. Contact 14 is adapted to bridge segments 17 and 18, contact 15 is to bridge segments 19 and 20, and contact 16 bridges contacts 21, 22 and 23. Segment 15 also engages contact stud 24 when the arm is moved to the running position.

A magnet winding 25 of the solenoid type is mounted adjacent to the segments, as shown, and is provided with a plunger or core 25', connected by means of a link 26 with a latch 27 pivoted to the base at 28. A spring 29 holds the latch in the position shown when the magnet is deenergized, but when the magnet is energized, the latch will be rocked so as to place the spring 29 under tension. The pin 30 on the arm 11 is arranged to abut against the latch 27 when the latter is moved by the plunger, but when the magnet is deenergized, and the latch is in the position shown in the drawing, the pin may move past the end of the latch so as to be engaged by the shoulder 31 on the latch when the magnet is reenergized.

The arrangement of circuit and mode of operation is as follows: S represents the primary windings or stator of an induction motor shown with a three-phase winding Y-connection.

R is the rotor or secondary of the motor which may be of the usual squirrel-cage type.

Two of the windings 32 and 33 are connected to the source of current through segments 22 and 23 and contact 16, conductor 34, conductor 35, segments 17 and 18, and contact 14. The third winding 36 is connected through magnet 25 to segment 20, through conductors 37 and 38. The resistance 39 is connected from segment 21 to conductor 38 as shown, and the reactance 40 is connected to the winding 32 at 41 and to the segment 19. The resistance 39 and the reactance 40 constitute phase-splitting devices for displacing the phase in a well known manner.

When it is desired to start the motor, the arm 11 is moved to right so that the contacts thereon engage the segments on the base. When the contact is first made, current will pass through the motor from positive main 42 to segment 23, contact 16, segment 22, conductor 34, windings 33 and 32, conductor 35, segment 17, contact 14, segment 18 back to line at 42'. Current will

also pass through from main 42 to segment 23, contact 16, segment 21, resistance 39, conductor 38, magnet 25, conductor 37, windings 36 and 32, segments 17 and 18, back to line; also from main 42 to segment 22, thence through windings 33 and 36, magnet 25, segment 20, segment 19, reactance 40 and back to line, through segments 17 and 18. This gives the motor the necessary starting torque, which, therefore, starts to rotate. As soon as the magnet is energized, the latch 27 is moved into the path of the pin 30, so that the arm or lever cannot be moved out of contact with the segments. As the motor begins to speed up, the energy of the magnet 25 begins to decrease. The decrease in the flow of current through this magnet as the motor speeds up is due to the following cause: it is a well known fact that a single-phase induction motor at starting has a simple, pulsating, unidirectional field due to the single-phase current supplied thereto, while when the motor is up to speed, a rotary field exists. In other words, the rotation of a secondary member causes a cross-magnetization which induces in the motor windings an electromotive force in quadrature with the impressed electromotive force. Consequently, in the arrangement shown in Fig. 2, the magnet winding 25 at starting has impressed upon it a voltage due only to the phase-splitting devices. As the motor speeds up the cross-magnetization rises and induces an electromotive force in the primary winding of the motor in quadrature to the impressed electromotive force and counter to the electromotive force of the phase-splitting devices. Consequently, as this counter-electromotive force increases, the current through the magnet winding 25 falls, and when the motor is brought up to running speed, the energy of the magnet is practically zero and the spring 29 therefore draws the latch 27 out of the path of the pin 30, so that the arm 11 may be moved into running position. When this position is reached, the contact 15 bridges segment 20 and contact stud 24, the contact 15 passes off segment 19, and the contact 14 still bridges segments 17 and 18. Contact 15 in passing off the segment 19 opens the circuit of the reactance 40 and the circuit of winding 33 and resistance 39 is broken by the passing of the contact 16 off segments 21 and 22. The circuits will then be as shown in Fig. 3, the magnet 25 being energized as follows: from main 42 and segment 23, to contact stud 24, segment 20, conductor 38, magnet 25, conductor 37, windings 36 and 32, segments 17 and 18, and back to line. The magnet thus being in series with the main motor windings is again energized and draws the latch 27 down so that the shoulder 31 engages the pin 30 and holds the arm 11 in running position. Upon failure

of voltage the magnet 25 will be deenergized and the arm 11 will be returned to the off position in the usual manner.

It will be seen that I have provided a simple and efficient device for bringing the motor up to running speed without danger to the motor and also for placing the motor in a protective position upon the failure of voltage.

Various modifications of my invention will, of course, suggest themselves to those skilled in the art, without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

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

1. The combination with an alternating-current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, and a magnet winding connected to be energized in quadrature to the main motor windings for limiting the operation of said switch.

2. The combination with an alternating current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, a magnet winding connected to be decreasingly energized during starting, means whereby the magnet is connected in series with the motor during running, and means controlled by the magnet for holding the switch in the running position.

3. The combination with an alternating-current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, a magnet winding connected in the motor circuit, and means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed.

4. The combination with an alternating-current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, a magnet winding connected in the motor circuit, and means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed, and then holding the switch in running position.

5. The combination with an alternating-current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, a magnet connected to be energized in quadrature to the main motor windings, means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed, and means whereby the

magnet is connected in the main motor circuit when the switch is moved to running position to hold the switch in said position.

6. The combination with an alternating-current motor having different connections of the windings for starting and running, of a switch therefor having the starting position between the off position and the running position and biased to the off position, a magnet winding connected to be energized in quadrature to the main motor windings, and means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed.

7. The combination with an alternating current motor having different connections of the windings for starting and running, of a switch biased to the off position for changing said connections, a magnet winding for limiting the movement of said switch and means whereby when the switch is moved to starting position the magnet is decreasingly energized during starting and when the switch is moved to running position it is energized in series with the motor.

8. The combination with an alternating current motor having different connections of the windings for starting and running, of a switch biased to off position for changing said connections, a magnet winding connected to be decreasingly energized during starting, means for connecting said magnet in series with the motor during running, and means controlled by said magnet for preventing the movement of the switch to running position until the motor reaches a predetermined speed and then locking said switch in running position.

9. The combination with a single-phase induction motor and phase-splitting devices for starting said motor, of a switch biased to the off position and arranged to cut said devices out of circuit, a magnet winding connected in circuit with the motor, and means controlled thereby for preventing the movement of the switch to running position when the magnet is energized, and for holding the switch in running position when running conditions are established.

10. The combination with a single-phase induction motor and phase-splitting devices for starting said motor, of a switch arranged to cut said devices out of circuit, a magnet connected to be energized in quadrature to the main motor windings, and means controlled by said magnet for preventing movement of the switch to running position while the magnet is energized.

11. The combination with an alternating current motor having different connections of windings for starting and running, of a switch therefor having a starting position between the off and the running position and biased to the off position, magnet wind-

ings connected to be energized in quadrature to the main motor winding, and a latch controlled by said magnet and arranged to prevent movement of the switch to running position under predetermined conditions of the motor circuit.

12. The combination with a single phase induction motor, a phase-splitting device for starting the same, of a switch arranged to cut said device out of circuit, a magnet connected so as to have impressed upon it an electromotive force due to the phase-splitting device during starting and connected in series with the motor during running, and means for preventing the movement of the switch to running position until the motor reaches a predetermined speed and then locking the switch in running position.

13. The combination with a single-phase induction motor and phase splitting device for starting the same, of a switch biased to the off position and arranged to cut said device out of circuit, a magnet winding connected to be energized in quadrature to the main motor windings when the switch is in a starting position, connections whereby said magnet is reenergized when the switch is moved to running position, a device controlled by said magnet for preventing the movement of the switch to running position until the magnet is deenergized and for locking the switch in running position when the magnet is reenergized.

14. The combination with an alternating current motor, of a starting switch therefor biased to off position, a magnet winding for controlling said switch connected so as to be decreasingly energized during starting and means for connecting said magnet in series with the motor during running.

15. A starting device for electric motors comprising a switch biased to off position, a magnet winding having different connections in the motor circuit for starting and running, and means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed, then holding the switch in running position.

16. A starting device for electric motors comprising a switch biased to off position, a magnet winding connected in the motor circuit so as to be decreasingly energized during starting of the motor, means whereby said magnet is caused to be energized uniformly during running, and a latch controlled by said magnet for preventing the movement of the switch to running position until the motor reaches a predetermined speed and then holding the switch in running position.

17. A starting device for electric motors comprising a switch having a starting position between the off and the running position and biased to the off position, and

means for preventing the movement of the switch to running position until the motor reaches a predetermined speed, and then holding the switch in running position.

- 5 18. A starting device for electric motors comprising a switch having a starting position between the off and the running position and biased to the off position, a magnet winding connected to be decreasingly energized during starting, means whereby said
10 magnet is caused to be energized uniformly during running, and means controlled by said magnet for preventing the movement
15 of the switch to running position until the motor reaches a predetermined speed and for holding the switch in running position.

19. The combination with an electric motor, of a starting device therefor comprising a switch biased to the off position, a magnet winding having different connections in the motor circuit during starting and running, and means controlled thereby for preventing the movement of the switch to running position until the motor reaches a predetermined speed, and then holding the switch in running position. 25

In witness whereof, I have hereunto set my hand this 23rd day of September, 1907.

LAURENCE A. HAWKINS.

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."