

W. C. YATES.

STARTING DEVICE FOR ALTERNATING CURRENT MOTORS.

APPLICATION FILED OCT. 18, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

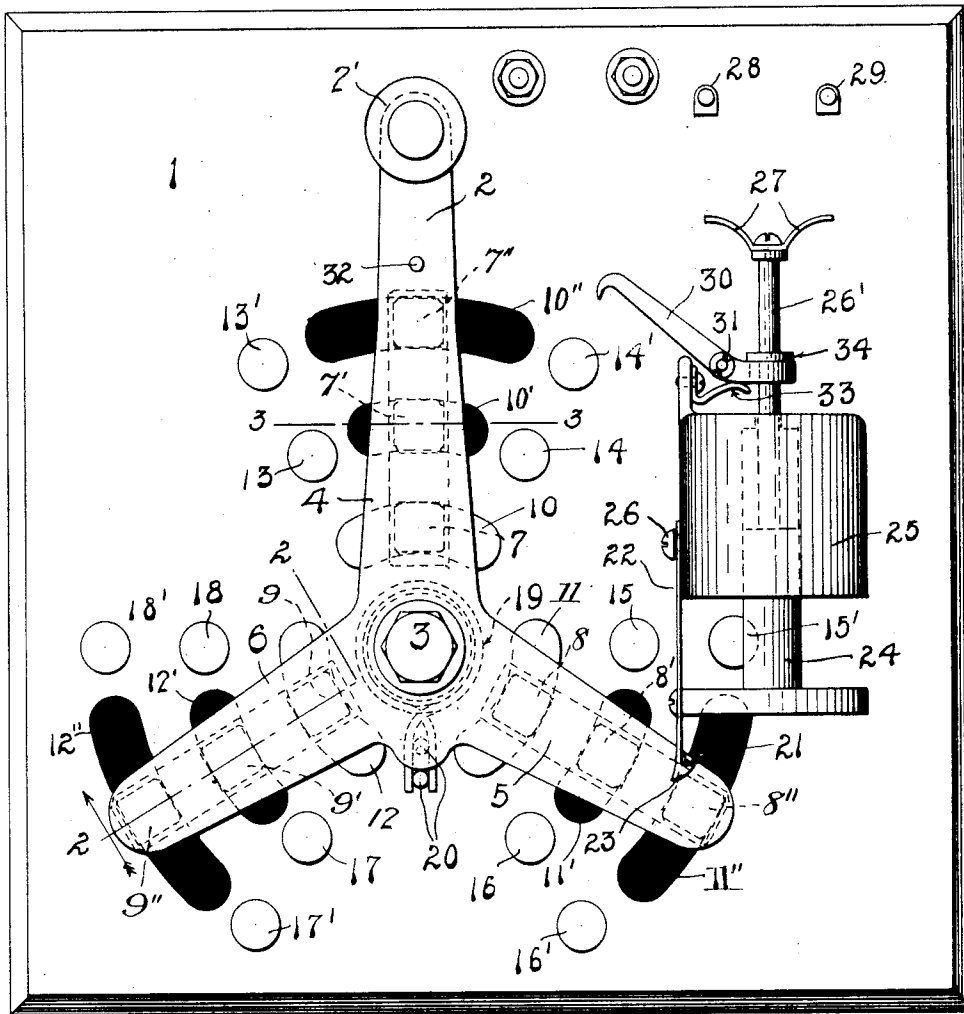


Fig. 2.

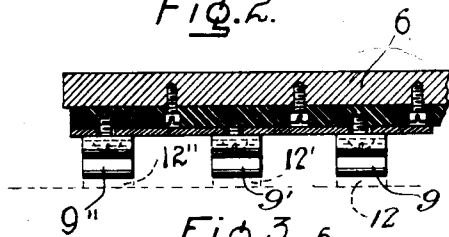
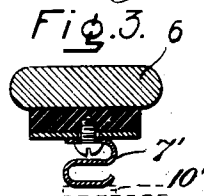


Fig. 3.



WITNESSES:

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INVENTOR:

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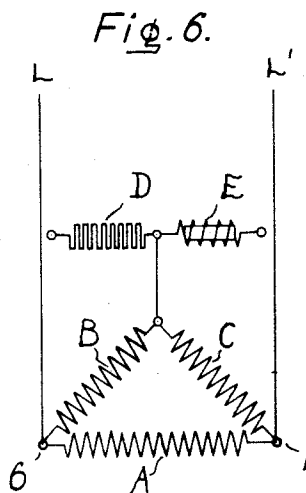
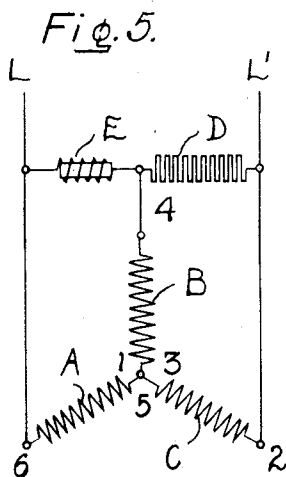
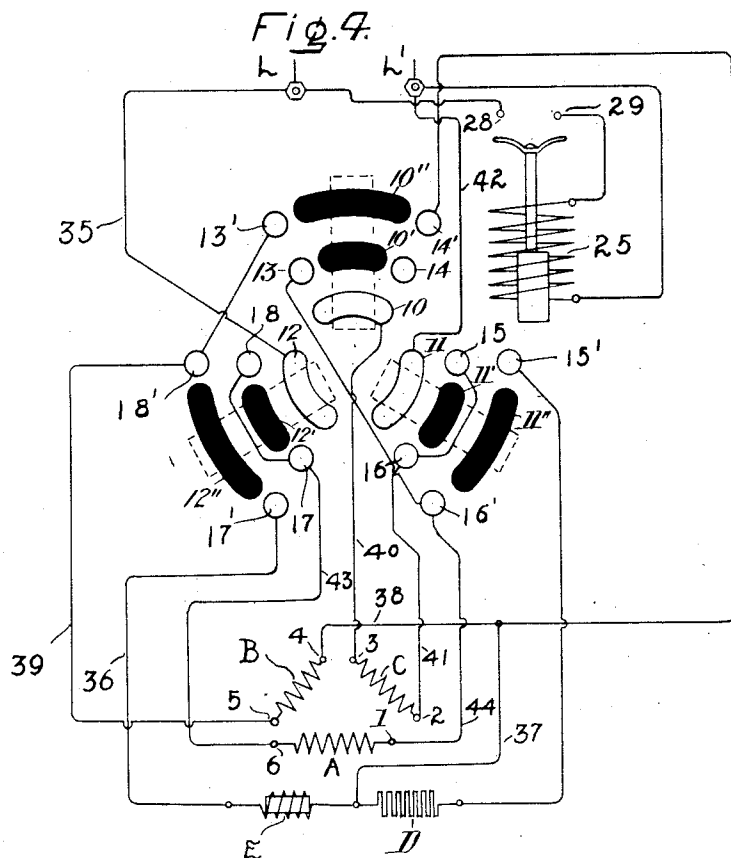
by Albert G. Davis
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2 SHEETS—SHEET 2.



WITNESSES:
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Benjamin B. A. Hill

INVENTOR:
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UNITED STATES PATENT OFFICE.

WILLIAM C. YATES, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STARTING DEVICE FOR ALTERNATING-CURRENT MOTORS.

No. 867,547.

Specification of Letters Patent.

Patented Oct. 1, 1907.

Application filed October 18, 1905. Serial No. 283,247.

To all whom it may concern:

Be it known that I, WILLIAM C. YATES, 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 a device for starting motors of the induction type and bringing them up to running speed in a cheap, safe and efficient manner.

More specifically my invention relates 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 auxiliary starting winding or phase splitting devices connected in the motor circuit, or both. Devices of this character are designed to be in circuit only for a short period during which the motor is being brought up to synchronism and if left in circuit too long will become over-heated. Means have therefore been employed for changing the connections so as to cut out these auxiliary starting devices. In the case of motors with three phase windings, which are to be operated on single phase current, it has been the practice to use a triple-pole double-throw switch which, when thrown in one position starts the motor with its windings Y-connected with the addition of a resistance-reactance device for producing a displaced phase at the third terminal. After the motor has been brought up to speed, the switch is thrown into the opposite position which cuts out the resistance-reactance device and places the motor with its windings delta-connected directly on the line. With an arrangement of this character there is nothing to prevent the operator from throwing the switch into the starting position and leaving it there, or from throwing the switch into the running position directly, without passing through the starting position. Moreover, this type of device provides no means for throwing the switch into the off position on failure of voltage so as to protect the motor upon the return of voltage to the line.

In carrying out my invention I provide instead of the knife blade switch, a dial switch having three arms set at an angle of 120° from each other and biased to the off position. The connections are such that by moving the switch arm in one direction from the off position, starting conditions are established, while by moving in the opposite direction running conditions are established. In connection with this device, I provide means whereby the arm cannot be moved from the off position directly to the running position, but must first be moved to the starting position. The

movement to the starting position removes a stop from the path of the switch arm which is electromagnetically retained in the removed position, and the arm may then be moved to the running position. I also provide a no-voltage magnet, the circuit of which is closed when the arm reaches the starting position and means are provided in connection with this magnet for locking the arm in running position. This magnet also controls the stop device so that upon failure of voltage the starting arm is released and returned to the off position, the stop also being returned to the path of the starting arm.

My invention further consists in the features of construction and in the arrangement and combination of elements hereinafter set forth and particularly pointed out in the claims annexed to and forming a part of this application.

In the drawings, Figure 1 is a plan view of a starting device embodying my invention; Fig. 2 is a section on the line 2 2 of Fig. 1; Fig. 3 is a section through one of the contact clips; Fig. 4 is a diagram of circuit connections, and Figs. 5 and 6 show respectively the connections of the windings and the resistance-reactance for starting and running.

Referring to the drawings, 1 is an insulating base of slate or soap stone provided with three sets of contacts having a controlling member pivoted for engagement therewith. This controlling member 2 is pivoted at 3 and provided with three arms 4, 5 and 6 arranged 120° apart; one of the arms being provided with a handle 2' for operating the same. Each arm is provided with three contact clips 7, 7' and 7'', 8, 8' and 8'', and 9, 9' 9'', which are electrically connected together but insulated from the arm and from the contacts on the other arms. The contacts 7, 8, and 9 engage respectively, with the conducting segments 10, 11 and 12, while the remaining contacts engage respectively with the insulating segments 10', 11', 12' and 10'', 11'' and 12'', as shown when the controlling arm is in the off position. The contacts engage with these segments but upon the movement of the arm either to the left or to the right, the contacts pass out of engagement with the insulating segments while the contact with the conducting segments continues. Contact studs 13, 14, 15, 16, 17, 18, and 13', 14', 15', 16', 17' and 18' are arranged one opposite each end of each insulating segment so that as the arm is moved off the insulating segment in either direction from the center, it will move into engagement with the studs, and there will thus be electrical connections between the studs and the conducting segment of each section, that is, when the arm is moved to the left the segment 10 will be electrically connected with the studs 13 and 13' and similar connections will be made in the other sections. The

spring 19 cooperating with the pins 20 in the base and on the arm gives the arm a bias to the off or central position.

In my device as herein shown, the connections are such that as the arm is moved to the left the starting conditions are established, while a movement in the opposite direction establishes connections for running. In order, therefore, to prevent the movement of the arm to the right before it has first been moved on to the contact studs to the left, I provide the following mechanism: A lug 21 is mounted upon the arm 5 and arranged to be engaged by the stop piece 22 having at its extremity a shoulder 23. This stop piece is secured to the core armature 24 of the no-voltage magnet 25 and a guide screw 26 is secured to the magnet for guiding the stop piece in its up and down movement. At the upper extremity of the core armature 24 is a rod 26' provided with a bridging contact 27 adapted to close the circuit between contacts 28 and 29 when it reaches the outer and upper limit of its movement. A latch 30 is pivoted at 31 and provided with a hook for engaging the pin 32 on the arm 4 when the latter is moved to running position. This latch is provided at its end opposite the hook with a hub portion which forms a guide bearing for the rod 26'. A spring 33 normally forces the hook portion of the latch downward so as to engage the pin 32, and a collar 34 rigidly secured to the rod 26 engages the hub portion of the latch as it travels downward to move the hook upward against the tension of the spring.

The armature 24 and magnet 25 are so arranged that the former will be engaged by the arm 5 and as the controlling arm is moved to the left, the stop 22 is carried up with the armature so as to be out of the path of the lug 21. The armature is forced upward by the arm 5 until the contacts 28 and 29 are bridged, closing the circuit of the magnet 25, which upon being energized holds the armature 24 in raised position and thereby keeping the circuit closed and allowing the hook portion of the latch to descend so as to engage the pin 32 when the arm is moved to running position. The arm may now be moved to running position and there latched. Upon failure of voltage the armature will drop, opening the circuit and bringing the stop piece again into the path of the lug 21. As the armature drops the collar 34 engages the latch, trips the same and allows the controlling arm to return to the off position.

I have shown my device in connection with a motor having a three phase winding to be operated by a single phase current, and in order that the motor may be started from rest under these conditions a split phase device is employed. The starting connections are shown in Fig. 5 in which the motor windings A, B, and C are V-connected with the resistance D and a reactance E connected across the line L L' so as to produce a displaced phase, this form of connection being well known in the art. After the motor gets up to speed, the resistance-reactance is cut out and the windings are delta connected across the line as shown in Fig. 6. The circuit connections whereby my switch brings about the change from starting to running connections are shown in Fig. 4. With the controlling arm moved to the left into starting position, current passes from the line L to contact 28 and also by conductor 35 to segment 12, thence to stud 17', conductor 36 through the

reactance E, conductors 37 and 38 to winding B at 4, thence through the winding to 5 and conductor 39 to studs 18' and 13'. The current then passes to segment 10 across the arm 4 and thence through conductor 40 to winding C at 3, thence through the winding to 2 and through conductor 41 and studs 16 and 15 to segment 11, thence by conductor 42 to the line L'. Current also passes from stud 17 through the winding A to the center of the V connection at 1. With the switch in this position, the ends 1, 3, and 5 of the windings are connected at a common neutral point as shown in Fig. 5. When the arm is moved to the right the arrangement is as shown in Fig. 6: the windings being delta connected across the line and the resistance-reactance D E cut out, the direction of current will then be as follows:—from the line L through conductor 35 to segment 12, thence to stud 18, stud 17, conductor 43 to the winding A at 6, through the winding to 1 and conductor 44 to stud 16', thence through the arm 5 to segment 11 and out to line through conductor 42, the winding A being in parallel with the two windings B and C which are in series with each other. This establishes running conditions of the motor which are maintained until the arm is returned to the off position through failure of voltage. The magnet 25 is connected across the line L L' and in shunt to the motor.

While I have shown my device in connection with a particular type of motor, namely, a three-phase motor to be operated by a single phase current, it should be understood that I do not limit my invention in its application to this or any other type of motor except in so far as it is limited by the scope of the claims annexed to and forming a part of this application.

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 no-voltage magnet controlled by the switch for holding the latter in running position.
2. The combination with a single phase induction motor, of phase splitting devices for starting the same, a switch biased to the off position and arranged to connect the motor for starting or running, and a no-voltage magnet controlled by the switch for holding the latter in running position.
3. The combination with an alternating current motor having different connections for starting and running, of a switch therefor biased to an off position between the starting and running position, a no-voltage magnet for holding the switch in running position, and means controlled by said magnet for preventing the moving of the switch into one of the operative positions without first passing through the other operative position.
4. The combination with a single phase induction motor of phase splitting devices for starting said motor, a switch biased to the off position and arranged to connect the motor for starting or running, a no-voltage magnet for holding the switch in running position, and means controlled by said magnet for preventing the movement of the switch into the running position without first passing through the starting position.
5. The combination with an alternating current motor having different connections for starting and running, of a switch biased to the off position for changing said connections, a no-voltage magnet for holding the switch in running position, a stop controlled thereby for preventing the movement of the switch from the off position directly to

the running position, and means for removing said stop as the switch is moved to starting position.

5 6. The combination with an alternating current motor having different connections for starting and running, of a switch biased to the off position for changing said connections, a no-voltage magnet for holding the switch in running position, a stop controlled thereby for preventing the movement of the switch arm from the off position directly to the running position, and means whereby said stop is

removed and the circuit of said magnet closed by the movement of said switch to starting position. 10

In witness whereof I have hereunto set my hand this 17th day of October, 1905.

WILLIAM C. YATES.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.