No. 809,787. PATENTED JAN. 9, 1906.

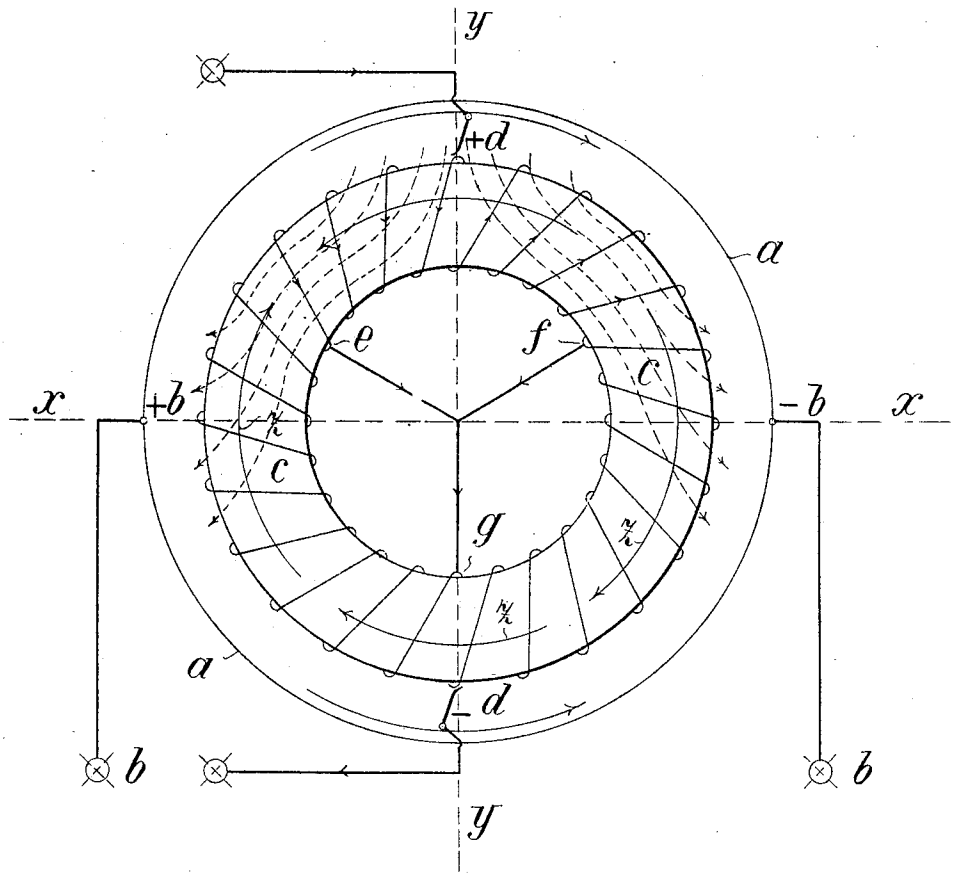
M. DÉRI.

ALTERNATING CURRENT MOTOR.

APPLICATION FILED MAY 2, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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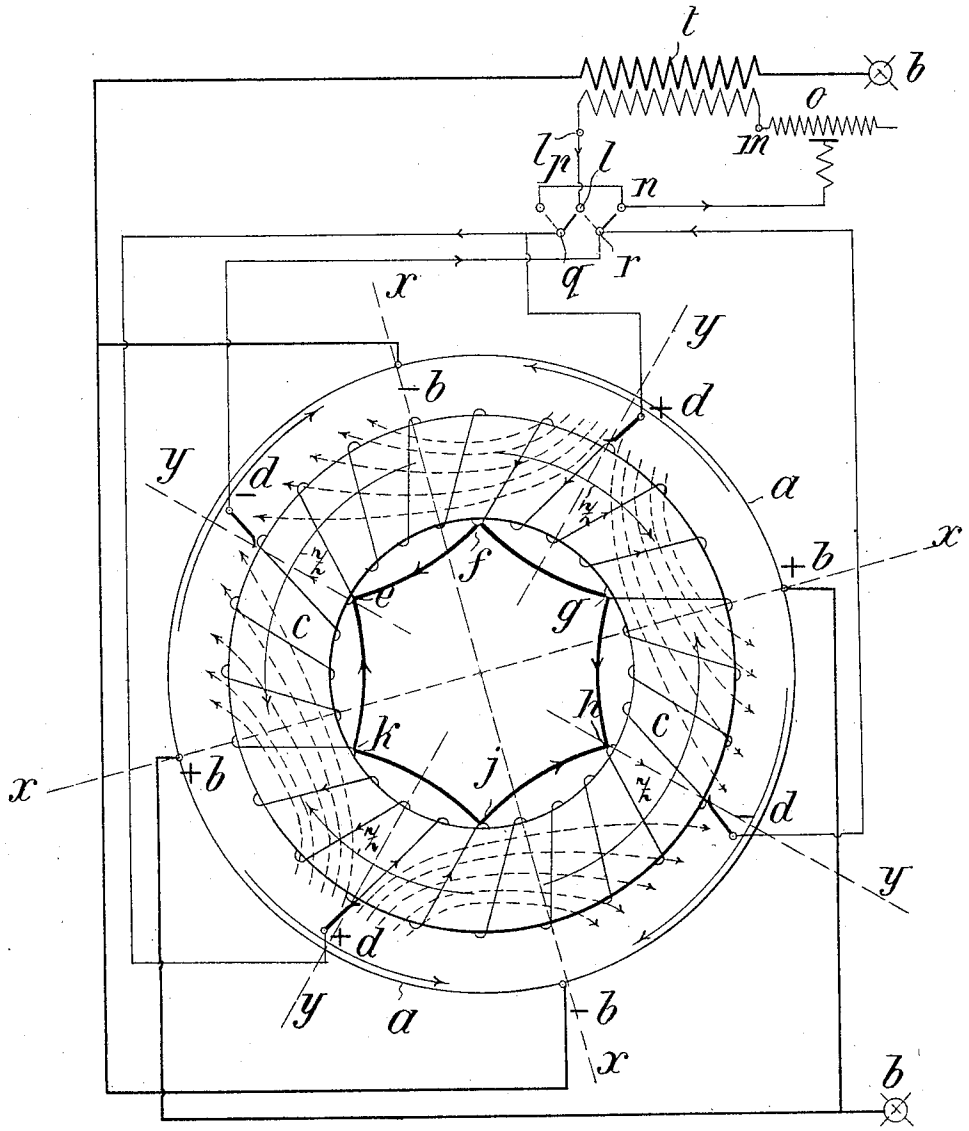
Fig. 2.



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UNITED STATES PATENT OFFICE.

MAX DÉRI, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNOR TO STANLEY ELECTRIC MANUFACTURING COMPANY, OF PITTSFIELD, MASSACHUSETTS.

ALTERNATING-CURRENT MOTOR.

No. 809,787. Specification of Letters Patent. Patented Jan. 9, 1906.

Application filed May 2, 1904. Serial No. 205,967.

To all whom it may concern:

Be it known that I, MAX DÉRI, a subject of the Emperor of Austria-Hungary, residing at Vienna, Austria-Hungary, have invented certain new and useful Improvements in Alternating-Current Motors, of which the following is a specification.

This invention relates to single-phase induction-motors with short-circuit armature; and it consists in providing means for introducing special currents into the rotor-windings by a commutator and brushes, which currents, without obviously interfering with the simultaneously-occurring short-circuit induction, serve to energize the magnetic field for the purpose of producing a torque of any desired strength, which may be regulated by varying the said currents. As in the ordinary induction motor so in this arrangement the stator-winding is connected to the source of current, whereby currents are induced in the rotor-winding (which is short-circuited in definite groups without the aid of slip-rings) that are equivalent to the energy-currents of the stator, and which I will therefore call "working" currents.

The exciting-currents are taken from the source as nearly as possible in phase with the working currents, either directly or by means of a transformer, and are led into the collector device. The exciting-currents in flowing through part of the rotor-winding produce, corresponding to the position of the brushes, a field transversely to the axis of the induction, and consequently also transversely to the working currents. When the rotor revolves, there is produced by induction due to cutting the primary field not only an additional electromotive force in this exciting-circuit, which assists the external excitation, but also in the short-circuit armature a magnetic flux increasing with the speed, which has the same direction as the field excited separately on starting. The field of the motor determining the torque—the motor-field—is constituted by the above two components—*i. e.*, that due to the exciting-currents supplied from the outside source and that due to the short-circuit rotor-currents induced by cutting the primary field. By varying the exciting-currents supplied from the outside (and consequently easily accessible) by means of resistances, pressure-regulators, and the like, or by reversing, so as to act counter to the self-excited magnetic flux, also by shifting the brushes, whereby the operative component of the excitation is varied, the motor-field can be increased, decreased, or reversed. By this means every possible regulation of the torque and speed of the induction-motor can be carried out. The working currents always flow in short-circuited windings without passing into the commutator devices.

The commutator device serves exclusively for exciting the motor-field. Consequently only weak and easily-commutable exciting-currents flow through the commutator and brushes. These devices can therefore be made simpler and smaller than in the case of ordinary commutator-motors or of those motors whose commutator appliance carries the entire rotor-current during starting and acceleration. The definite functions, on the one hand, of the short-circuiting device, and, on the other hand, of the commutator device in this motor remain unchanged at every speed, as also does the pole-number and the short-circuit arrangement. Consequently no devices such as slip-rings, resistances, and switch connections are necessary, which are used with other modified single-phase motors in order to vary the armature function at starting and at full speed or to vary the pole-number, the short-circuits, &c.

Referring to the accompanying drawings, Figures 1 and 2 show diagrammatically the windings and connections of the above-described motor for two and for four poles, respectively.

The stator-winding is indicated by the circle *a* and its points of connection to the source are shown at *b*. The rotor *c* is represented for the sake of simplicity with ring-winding and with brushes $+d$ and $-d$ lying directly upon the winding. The points of the rotor-winding between which the short-circuiting connections are arranged are indicated by *e f g*, &c.

The pole-axis of the stator-winding, and consequently the axis of the primary field, is indicated by x, and the pole-axis, determined by the brushes of the separately-excited motor-field, is indicated by y.

The course of the induced rotor-currents is indicated by arrows z, and the magnetic flux of

the field, excited from outside, by dotted parallel lines, while the exciting-currents are indicated by arrows on the respective leads.

Fig. 1 shows the action in a bipolar arrangement. The rotor-winding is short-circuited by a three-part connection between the points *e*, *f*, and *g*. In the position of the rotor shown the exciting-currents flow from $+d$ through the rotor-windings, on the one hand, toward *e*, on the other hand toward *f*, then through the short-circuiting wires (without passing into the windings between *e g* and *f g*) to *g* and $-d$. The magnetic flux produced by these currents passes from $+d$ toward *e* and *f*, where it issues on both sides of the rotor. The magnetic flux consequently passes transversely through the windings, carrying induction-currents both at its entrance and at its exit in such manner that at both sides torques are produced having the same definite direction. With a position of the rotor shifted sixty degrees from that shown the active part of the device is situated on the opposite side at the brush $-d$. The torque has the same direction as before. During the rotation the transfer of the field is effected gradually from one brush to the other.

Fig. 2 shows, by way of example, a four-polar arrangement in which the six-part connection *e f g h j k e* effects the short-circuiting. The course of the induction-currents and of the magnetic flux excited from the outside shows that the tractional forces are diametrically *in equilibrio*. At intervals of thirty degrees rotation the magnetic flux is intensified at successive pairs of opposite equipolar brushes and in leaving the rotor is distributed in the diametrically opposite zones between said pairs of brushes. Instead of the six-part connection three, five, or seven part connections, &c., might be employed in the arrangement at Fig. 2. The short-circuitings of uneven number would be subject to the disadvantage that tractional forces of one-sided action would be produced similar to the arrangement at Fig. 1. Care must be taken to insure that the contiguous connecting-wires never effect a direct connection between brushes of opposite sign, also that the paths of the lines of force which appear between the brushes of opposite sign are not entirely choked by the short-circuiting, which would be the case, for instance, with a four or eight part short-circuiting or with a short-circuiting of all the windings. In general the number of short-circuited points should be small and should be indivisible by the number of poles of the motor. In Fig. 2 there is also shown the connection of the exciting-circuit with the source of current and the stator-winding. According to this example the brushes for the exciting-currents are connected to the secondary winding of the transformer *t*, the primary winding of which is connected to the main circuit at *b*. By this means the coincidence of the phases of primary and exciting currents is insured. The voltage which effects the excitation is situated between the points *l* and *m*, or, when taking into account the resistance introduced by means of a regulating device *o*, between the points *l* and *n*. The points are shown as contacts of a reversing-switch *p*, which serves for connecting the terminals *q* and *r* of the exciting-circuit with the source of voltage in the one direction or the other. The working and exciting currents instead of being included in the same winding, as shown in the drawings, can also be led through separate windings of the rotor. Only the exciting-winding in this case would be connected with the collector; but it is advisable also to short-circuit this in the same way as the working winding. The number of turns, the cross-section, as also the amount of copper, can be different for the two windings, according to the different amounts of current and energy that are passed through or consumed in them. Any desired number of poles and any system of winding can be employed both for stator and rotor.

I claim—

1. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indivisible by the number of poles of the motor, and means for supplying exciting-currents to the rotor-winding to produce a field at an angle to that due to the primary winding.

2. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indivisible by the number of poles of the motor, and means for supplying to the rotor-winding currents in phase with the primary current to produce a field at an angle to that due to the primary winding.

3. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indivisible by the number of poles of the motor, commutator-brushes arranged on a line at an angle to the line of magnetization produced by the primary winding, and connections from said brushes to a source of current substantially in phase with the primary current.

4. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indivisible by the number of poles of the motor, commutator-brushes arranged on a line at an angle to the line of magnetization produced by the primary winding, connections from said brushes to a source of current substantially in phase with the primary current, and a reversing-switch in said connections.

5. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indi-

visible by the number of poles of the motor, commutator-brushes arranged on a line at an angle to the line of magnetization produced by the primary winding, and a transformer having its primary in series with the primary winding of the motor and its secondary connected to said brushes.

6. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at a number of points indivisible by the number of poles of the motor, commutator-brushes arranged on a line at an angle to the line of magnetization produced by the primary winding, a transformer having its primary in series with the primary winding of the motor and its secondary connected to said brushes, and a reversing-switch in circuit with one of the windings of said transformer.

7. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at three points per pair of poles, and means for supplying exciting-currents to the rotor-winding to produce a field at an angle to that due to the primary winding.

8. In an alternating-current motor, a single-phase primary winding, a rotor-winding short-circuited at three points per pair of poles, commutator-brushes arranged on a line at an angle to the line of magnetization produced by the primary winding, and connections from said brushes to a source of current substantially in phase with the primary current.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

MAX DÉRI.

Witnesses:
ALVESTO S. HOGUE,
W. A. RUBLEE.