No. 792,102. PATENTED JUNE 13, 1905.

G. WINTER & F. EICHBERG.

ALTERNATING CURRENT MOTOR.

APPLICATION FILED NOV. 14, 1904.

Fig. 1.

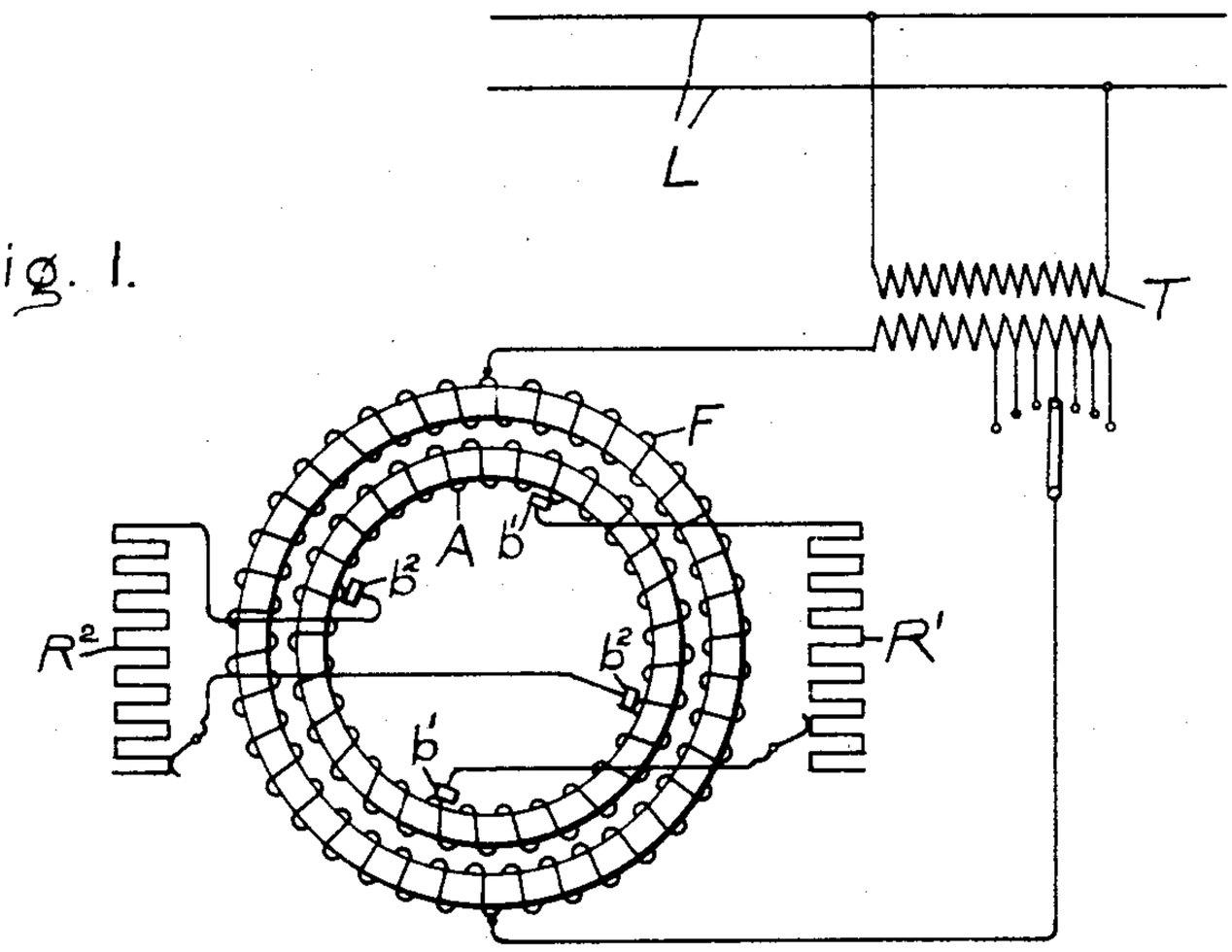
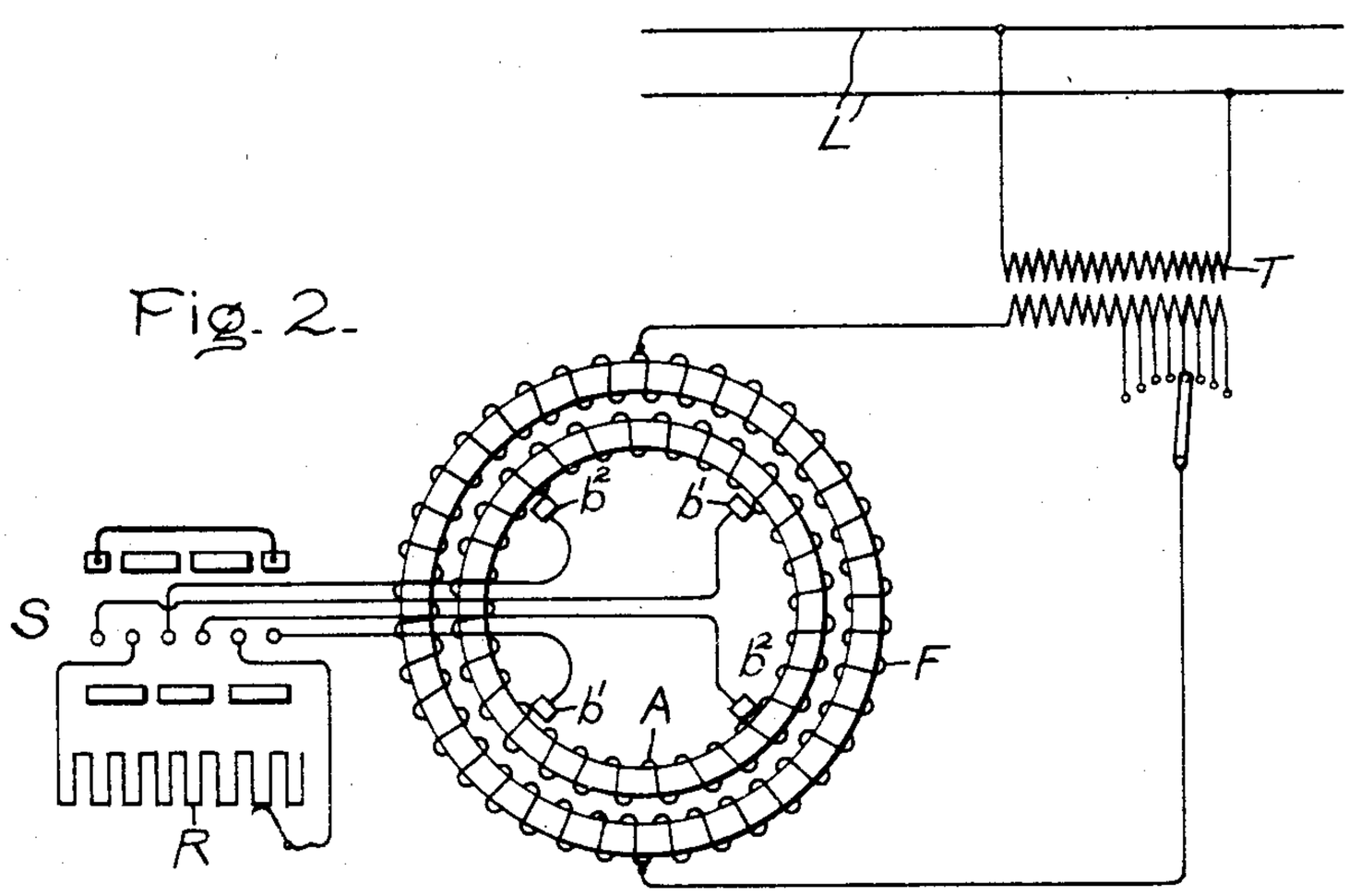


Fig. 2.



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No. 792,102. Patented June 13, 1905.

UNITED STATES PATENT OFFICE.

GABRIEL WINTER, OF VIENNA, AUSTRIA-HUNGARY, AND FRIEDRICH EICHBERG, OF BERLIN, GERMANY, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ALTERNATING-CURRENT MOTOR.

SPECIFICATION forming part of Letters Patent No. 792,102, dated June 13, 1905.

Application filed November 14, 1904. Serial No. 232,608.

To all whom it may concern:

Be it known that we, GABRIEL WINTER, residing at Vienna, in the Empire of Austria-Hungary, and FRIEDRICH EICHBERG, residing at Berlin, in the Empire of Germany, both subjects of the Emperor of Austria-Hungary, have invented certain new and useful Improvements in Alternating-Current Motors, of which the following is a specification.

Our invention relates to the control of alternating-current motors of the commutator type; and its object is to provide novel controlling means for such motors by means of which the torque, speed, and direction of rotation may be controlled at will.

The well-known type of alternating-current commutator-motor known as the "repulsion-motor," in which the armature is short-circuited on a line at an angle to the line of magnetization produced by the field-winding, possesses speed-torque characteristics similar to those of the direct-current series motor—that is, the starting torque is high and decreases with increased speed, theoretically becoming zero at an infinite speed. While these characteristics render it particularly suitable for certain kinds of use, this type of motor is not suited for certain other classes of work in which the load at times is very light, so that the motor would have a tendency to race. The single-phase induction-motor, on the other hand, has no starting torque, but has a large torque near synchronism and a definitely-limited speed. By short-circuiting the armature of a repulsion-motor on a second line at an angle to the first the speed-torque characteristics of the motor are modified, so that the motor possesses characteristics similar to those of an induction-motor at synchronism, having a definitely-limited speed, while, on the other hand, it retains a considerable starting torque.

By our invention we provide means for varying at will the relative effects of the two short circuits of the armature-winding, so that the motor may be caused to exhibit the characteristics of the repulsion or induction motor to a greater or less degree at will.

In its broad aspects our invention consists in inserting variable resistances in one or both short circuits, whereby the relative amount of current-flow in the two short circuits may be controlled at will, so as to vary the speed-torque characteristic of the motor. If the two short circuits are displaced symmetrically from the line of magnetization produced by the primary field and if the resistances of the two short circuits are equal, it is evident that the torques due to the currents in the two short circuits will be equal and opposite and the motor will have no resultant starting torque. If, however, the current in one of the short circuits is limited or made less than the other, the torque due to the current in the other short circuit will preponderate and the motor will have a resultant starting torque of a magnitude dependent on the difference in current-flow in the two short circuits. By limiting the current-flow in one or the other of the two short circuits the motor may be caused to start in one direction or the other at will. Then when the motor is up to speed by removing the resistance from the short-circuiting connections the motor will operate as an induction-motor.

More specifically considered, then, our invention consists in short-circuiting the motor on two lines symmetrically displaced from the line of magnetization produced by the field-winding and controlling the relative amount of current-flow in the two short circuits.

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

Figure 1 shows diagrammatically a repulsion-motor provided with an auxiliary set of brushes displaced ninety degrees from the usual set and each set short-circuited through a variable resistance; and Fig. 2 shows a motor in which the two sets of brushes are displaced symmetrically from the line of magnetization produced by the primary winding, together with a reversing-switch for connecting a resistance in either short circuit.

Referring first to Fig. 1, F represents the primary or field winding, and A the second-

ary or armature winding, of an alternating-current motor. For the sake of simplicity both members are shown as provided with bipolar Gramme-ring windings; but it will be understood that our invention is applicable to a motor with any well-known form of winding and that in practice the usual distributed drum-winding placed in slots in a laminated-iron structure would be employed. The primary winding F is connected to the line-wires L through a variable-ratio transformer T, by means of which the voltage impressed upon the primary may be varied and the starting-current limited. The armature is provided with the usual set of commutator-brushes b' b', displaced by a small angle from the line of magnetization produced by the field-winding. These brushes we have shown short-circuited through a variable resistance R'. By means of this resistance the starting-current of the motor may be controlled in combination with or instead of the control of the primary impressed voltage. A second set of commutator-brushes b^2 b^2 are displaced approximately ninety degrees from the first set and are short-circuited through a second variable resistance R^2. It is by means of this second set of brushes that the motor is caused to exhibit the characteristics of an induction-motor near synchronism, and the relative effect of this short circuit may be varied by means of the resistance R^2. Thus by variation of resistance R' or of resistance R^2, or both, the speed-torque characteristics of the motor may be varied so as to resemble more or less, as desired, the characteristics of the repulsion or the induction motor. Either of the resistances may be omitted, if desired, and the entire control obtained by the other resistance.

In Fig. 2 the two sets of brushes b' b' b^2 b^2 are displaced symmetrically from the line of magnetization produced by the field-winding F. Evidently if both sets are short-circuited through resistances of equal amount the motor will have no starting torque, as has been heretofore explained. By means of the reversing-switch S, however, either set of brushes may be short-circuited directly and the other short-circuited through the variable resistance R. Thus if the movable contacts are moved downward to bring the upper set of movable contacts in engagement with the stationary contact-fingers the brushes b' b' will be short-circuited directly on themselves, while the brushes b^2 b^2 will be short-circuited through the resistance R. The motor will then have a resultant starting torque in the same direction as though the brushes b' b' alone were short-circuited, the amount of this starting torque depending upon the value of the resistance R. As the motor speeds up the resistance R may be gradually cut out, until at synchronism the motor operates as an induction-motor. If the reversing-switch is moved in the opposite direction, the brushes b^2 b^2 are short-circuited and the resistance is included in the circuit b' b'. The direction of the starting torque of the motor is consequently reversed and the motor starts in the opposite direction.

We do not desire to limit ourselves to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of our invention.

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

1. In an alternating-current motor, a rotor-winding provided with a commutator, commutator-brushes and connections short-circuiting said winding on a plurality of angularly-displaced lines, and means for varying the relative resistance of the short circuits.

2. In an alternating-current motor, a rotor-winding provided with a commutator, commutator-brushes and connections short-circuiting said winding on a plurality of angularly-displaced lines, and a variable resistance included in one or more of the short circuits.

3. In an alternating-current motor, a rotor-winding provided with a commutator, brushes bearing on said commutator, and variable resistances connecting said brushes and short-circuiting the rotor-winding on a plurality of angularly-displaced lines.

4. In an alternating-current motor, a rotor-winding provided with a commutator, commutator-brushes and connections arranged to short-circuit said winding on two lines symmetrically displaced from the line of field magnetization, and means for varying the relative resistances of the two short circuits.

5. In an alternating-current motor, a rotor-winding provided with a commutator, commutator-brushes and connections arranged to short-circuit said winding on two lines symmetrically displaced from the line of field magnetization, a resistance, and means for including said resistance in either of the two short circuits.

6. In an alternating-current motor, a rotor-winding provided with a commutator, commutator-brushes and connections arranged to short-circuit said winding on two lines symmetrically displaced from the line of field magnetization, a resistance, means for including said resistance in either of the two short circuits, and means for varying the amount of said resistance.

In witness whereof we have hereunto set our hands this 18th day of October, 1904.

GABRIEL WINTER.
FRIEDRICH EICHBERG.

Witnesses as to Gabriel Winter:
ALVESTO S. HOGUE,
AUGUST FUGGER.
Witnesses as to Friedrich Eichberg:
HENRY HASPER,
WOLDEMAR HAUPT.