No. 832,724. PATENTED OCT. 9, 1906.

F. EICHBERG.

ALTERNATING CURRENT MOTOR

APPLICATION FILED JAN. 12, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

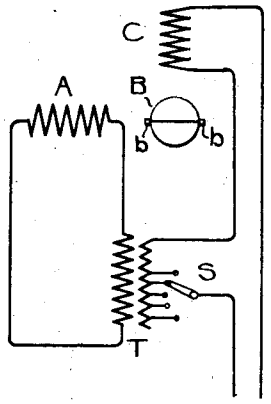
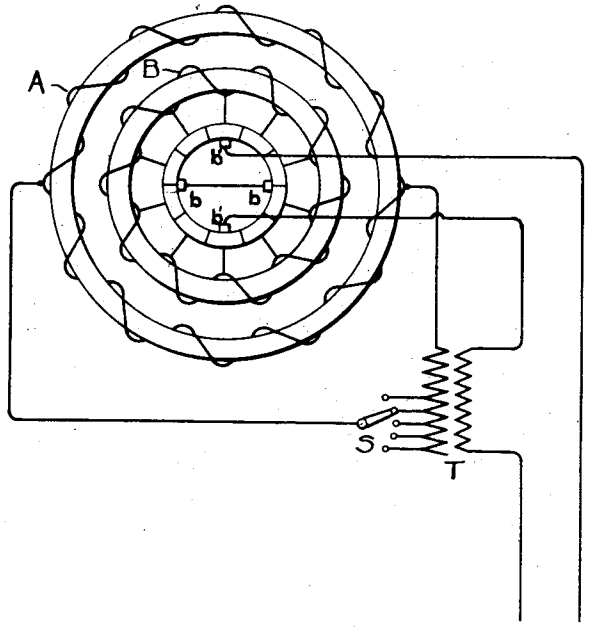



Fig. 2.




Witnesses.

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2 SHEETS—SHEET 2.

Fig. 3.

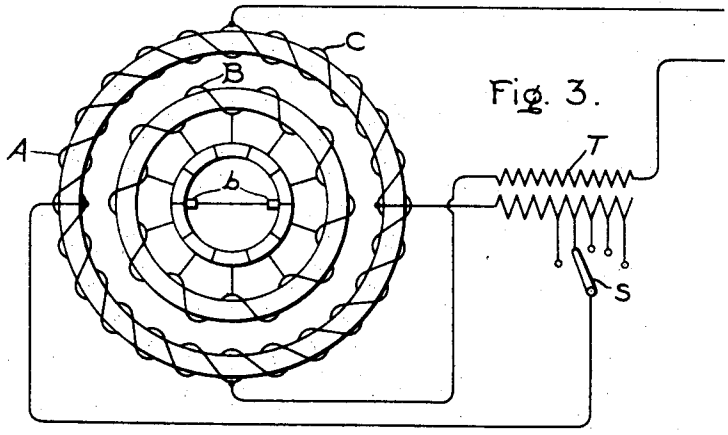



Fig. 4.

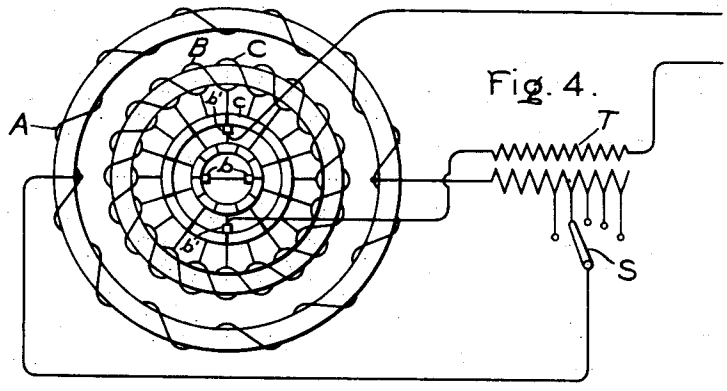
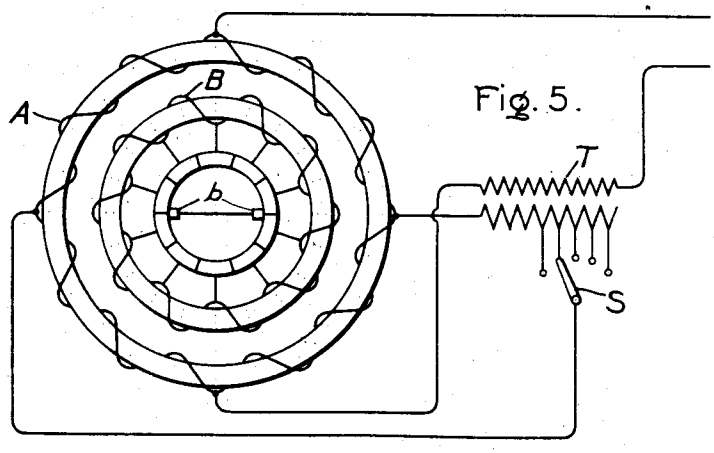



Fig. 5.




Witnesses:

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Att'y.

# UNITED STATES PATENT OFFICE.

FRIEDRICH EICHBERG, OF BERLIN, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## ALTERNATING-CURRENT MOTOR.

No. 832,724. Specification of Letters Patent. Patented Oct. 9, 1906.

Application filed January 12, 1905. Serial No. 240,680.

*To all whom it may concern:*

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

My invention relates to the control of alternating-current motors of the commutator type; and it consists in a modification of the invention disclosed in a former application of Gabriel Winter and myself, Serial No. 146,692, filed March 7, 1903. In the former application we disclosed a form of alternating-current motor having three windings, one of which may be termed the "inducing-winding," supplied with single-phase alternating-current, the second relatively movable to the first and in inductive relation thereto, which may be called the "induced" winding, and the third, which may be called the "magnetizing-winding," supplied with current from the secondary of a series transformer the primary of which is in series with one of the first two windings. The magnetizing-winding is arranged to produce a magnetization at an angle to that of the other two windings, which, coacting with the currents of the other two windings, produces the motor torque. Either the induced or inducing winding may be stationary, and the the magnetizing-winding may be placed on the stator or rotor and combined with one of the other windings or independent therefrom.

My present invention consists in connecting the magnetizing-winding to the source and supplying the inducing-winding from the secondary of a transformer the primary of which is in series with the magnetizing-winding.

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

Figure 1 shows a diagram of connections. Fig. 2 shows diagrammatically my invention applied to the control of an alternating-current motor of the commutator type, and Figs. 3, 4, and 5 show modifications of the arrangement of the motor-windings.

In Fig. 1, C represents the magnetizing-winding, connected to a suitable source of current. A represents the inducing-winding, displaced ninety degrees from C and connected to the secondary of the transformer T, the primary of which is in series with the magnetizing-winding C. B represents the induced winding, which in this case is shown as the rotor provided with the brushes *b b*, connected to short-circuit the winding on the line of magnetization produced by the inducing-winding. S represents a switch by means of which the ratio of the transformer T may be varied so as to control the motor torque in a manner that has been heretofore explained in my former application. As has been said heretofore, the winding C may be placed upon either stator or rotor and may be combined with the induced or inducing winding or may be independent therefrom.

In Fig. 2 the magnetizing-winding is placed on the rotor and combined with the induced winding, the winding B in this figure performing the functions of both magnetizing-winding and induced winding. For this purpose it is provided with two sets of commutator-brushes, one set *b' b'* being connected to the source of current through the primary of transformer T, the portions of the rotor-winding between these brushes acting as the magnetizing-winding. The second set of brushes *b b* short-circuit the motor on the line of magnetization produced by the stator-winding A, and the portions of the rotor-winding between these brushes act as the induced winding. The inducing-winding, which is shown as the stator-winding, is connected, as before, to the secondary of the series transformer T. The number of turns of either primary or secondary of transformer T may be varied, and the two arrangements are shown in Figs. 1 and 2.

In Fig. 3 I have shown the magnetizing-winding C as a separate winding on the stator. The connections of the several windings are the same as heretofore described. In Fig. 4 I have shown the magnetizing-winding C as a separate winding on the rotor, provided with a separate commutator *c*. The connections are the same as in the preceding figures. In Fig. 5 I have shown the magnetizing-winding combined with the inducing-winding on the stator, the connections remaining the same.

Although for the sake of simplicity I have shown my invention applied to a motor having Gramme-ring windings on both members, it will be understood that my invention is applicable to any motor having the well-known

type of winding on either member. It will be understood that it is entirely immaterial for the purposes of my invention whether the magnetizing-winding is formed entirely separate from the inducing and induced windings, as in Figs. 3 and 4, or whether it is formed by the same coils which are also employed for either induced or inducing winding, as in Figs. 2 and 5. Consequently, although for the sake of convenience I employ the terms "magnetizing-winding," "inducing-winding," and "induced" winding in the appended claims, I desire it to be understood that I do not limit myself to a magnetizing-winding independent of the other two windings, but include a magnetizing-winding formed from the same coils which also serve for inducing or induced winding.

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

1. In an alternating-current motor of the commutator type, a winding supplied with alternating current, a transformer having its primary in series with said winding, a second winding connected to the secondary of said transformer and arranged to produce a magnetization at an angle to that of the first winding, and a winding short-circuited on the line of magnetization of the second winding and movable relatively thereto.

2. In an alternating-current motor of the commutator type, a winding supplied with alternating current, a transformer having its primary in series with said winding, a second winding connected to the secondary of said transformer, and arranged to produce a magnetization at an angle to that of the first, a winding short-circuited on the line of magnetization of the second winding and movable relatively thereto, and means for varying the ratio of transformation of said transformer.

3. In an alternating-current motor of the commutator type, a magnetizing-winding connected to a source of current, a transformer having its primary in series therewith, an inducing-winding displaced from the first winding and connected to the secondary of said transformer, and a short-circuited winding in inductive relation to the inducing-winding and relatively movable thereto.

4. In an alternating-current motor of the commutator type, a magnetizing-winding connected to a source of current, a transformer having its primary in series therewith, an inducing-winding displaced from the first winding and connected to the secondary of said transformer, a short-circuited induced winding in inductive relation to the inducing-winding and relatively movable thereto, and means for varying the ratio of transformation of said transformer.

5. In an alternating-current motor, a rotor-winding provided with a commutator, a set of brushes connected to a source of current, a transformer having its primary in series with said brushes, a second set of brushes short-circuiting the rotor-winding on a line displaced from the first set, and a stator-winding connected to the secondary of said transformer and arranged to produce a magnetization on the line of the second set of brushes.

6. In an alternating-current motor, a rotor-winding provided with a commutator, a set of brushes connected to a source of current, a transformer having its primary in series with said brushes, a second set of brushes short-circuiting the rotor-winding on a line displaced from the first set, a stator-winding connected to the secondary of said transformer and arranged to produce a magnetization on the line of the second set of brushes, and means for varying the ratio of transformation of said transformer.

7. In an alternating-current motor, a rotor-winding provided with a commutator, a set of brushes connected to a source of current, a transformer having its primary in series with said brushes, a stator-winding connected to the secondary of said transformer and arranged to produce a magnetization at an angle to that produced by the current through the rotor-brushes, and means for short-circuiting the rotor-winding on the line of magnetization of the stator-winding.

8. In an alternating-current motor, a rotor-winding provided with a commutator, a set of brushes connected to a source of current, a transformer having its primary in series with said brushes, a stator-winding connected to the secondary of said transformer and arranged to produce a magnetization at an angle to that produced by the current through the rotor-brushes, means for short-circuiting the rotor-winding on the line of magnetization of said stator-winding, and means for varying the ratio of transformation of said transformer.

In witness whereof I have hereunto set my hand this 21st day of December, 1904.

FRIEDRICH EICHBERG.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.