No. 731,887. PATENTED JUNE 23, 1903.

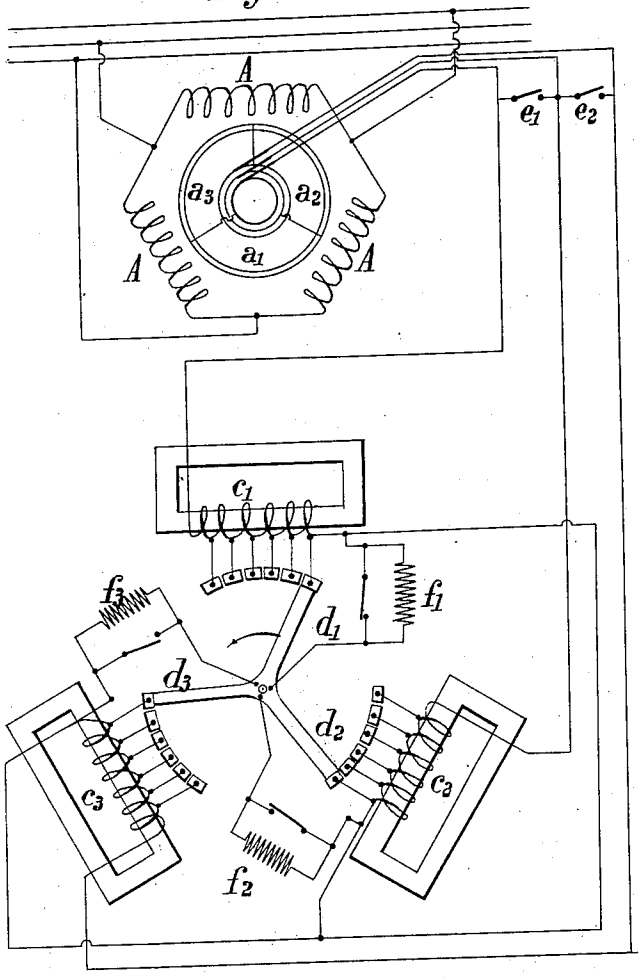
P. J. M. GIRAULT.

METHOD OF CONTROLLING ALTERNATING CURRENT MOTORS.

APPLICATION FILED APR. 26, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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John Brown.

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By
James L. Norris.
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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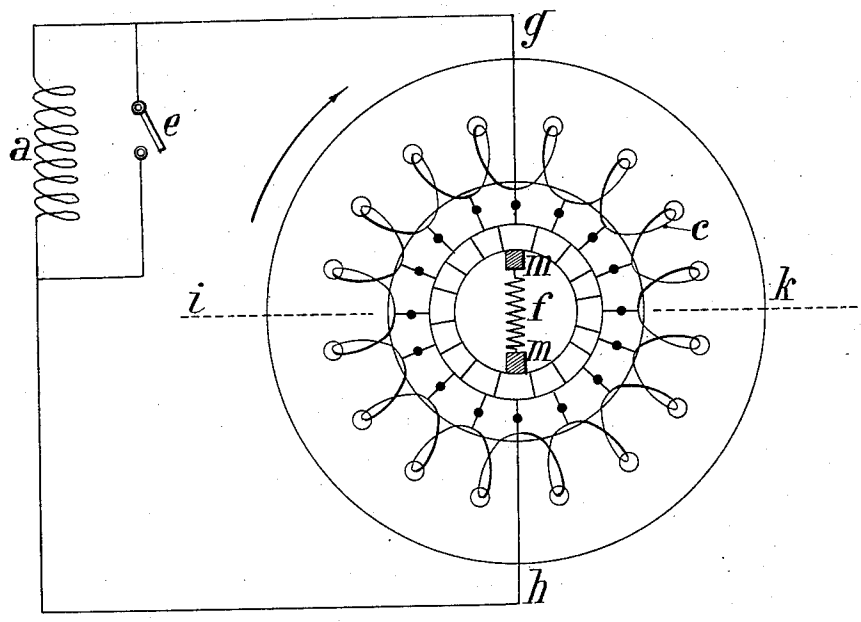
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APPLICATION FILED APR. 26, 1901.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.



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No. 731,887. Patented June 23, 1903.

UNITED STATES PATENT OFFICE.

PAUL JACQUES MATHURIN GIRAULT, OF PARIS, FRANCE.

METHOD OF CONTROLLING ALTERNATING-CURRENT MOTORS.

SPECIFICATION forming part of Letters Patent No. 731,887, dated June 23, 1903.

Application filed April 26, 1901. Serial No. 57,625. (No model.)

To all whom it may concern:

Be it known that I, PAUL JACQUES MATHURIN GIRAULT, engineer, a citizen of the French Republic, residing at Paris, France, (whose post-office address is 71 Rue Pamrémont, in the said city,) have invented certain new and useful Improvements in Methods of Controlling Alternating-Current Motors, of which the following is a specification.

Induction electric motors with revolving magnetic field and an armature of low resistance have the disadvantage of absorbing heavy currents when their inducing-fields are switched in the circuit and of being uncertain in their starting unless special devices be resorted to. I obviate this disadvantage by introducing resistances of known value into the armature-circuits and cutting them off gradually as the speed of the motor increases. I reduce the intensities of the current when inducing-fields are being switched in and insure the starting of the motors.

My said invention is based on the use of transformers with single windings, by means of which the apparent resistances of the armature-circuit are caused to vary in a continuous manner. By "apparent resistance" of a circuit I mean the ratio of the electromotive force generated in the said circuit to the effective intensity of the current flowing through it. This circuit can contain ohmic-resistance self-induction capacity and can be in inductive relation with another circuit, or it can be in connection with part of itself, which parts are put into short circuit.

Figure 1 shows, as example, an application of my invention to a three-phase-current motor. A A A are the inducing-circuits of the motor; a' a^2 a^3, the circuits of the armature; c' c^2 c^3, the single windings of the transformers, the turns of which are connected, respectively, to the fixed contacts of a commutator, on which a three-armed handle d' d^2 d^3 bears. By shifting the handle a gradually-increasing number of the sections of the single windings are short-circuited with the resistances f' f^2 f^3 of zero or finite value without these sections being able to be short-circuited apart. After this operation the apparent resistance of the circuits a' a^2 a^3 may be more diminished by short-circuiting successively the resistances f' f^2 f^3 and after the windings a' a^2 a^3 by closing the switches e' e^2.

It is obvious that one three-phase transformer only may be used instead of the three transformers of Fig. 1. The transformer may be of any convenient shape, (straight-line or annular shape.) Fig. 2 shows, for instance, a transformer of another shape. In this figure I have only shown one of the circuits of the armature in order to simplify the drawing. The circuit a is connected to the diametrically opposite points g and h of the single winding c of a cylindrical transformer having a series of channels of any convenient shape parallel to the axis for the reception of the winding c. This winding is closed within itself and like the windings of a continuous-current machine. The points of junction of the various individual sections of the winding c are connected to a collector, as in the case of a continuous-current armature. On this collector bear two brushes m m, connected to each other by a resistance the value of which is either zero or finite. It is clear that if the line m m joining the brushes coincides with i k there is no current passing through the resistance f. The apparatus works then toward the circuit a as a bobbin, having a very high self-induction. The current is then very weak and can be practically ignored. As the traveling contacts are moving in the direction of the arrow, the current passing through f, and consequently the current passing through g h, increases gradually in value and reach both their maximum when the line m m coincides with the line g h. The intensity of the current in the circuit a may then be slightly increased, or rather the apparent resistance of this circuit may be reduced to its smallest value, by first short-circuiting the resistance f (if f has a finite value) and then short-circuiting the winding of the transformer by means of the switch c.

It is obvious that my invention may be used with the simple alternating or polyphase current induction-motor with rotating field.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A method for controlling alternating-

current motors with revolving magnetic field, the induced circuits of which are connected with the terminals of a transformer having single windings, consisting of short-circuiting the sections of the winding on resistances of a determined value.

2. A method for controlling alternating-current motors with revolving magnetic field having their induced circuits connected with the terminals of a transformer with single windings consisting of dividing the winding of the transformer into sections which are suitably short-circuited on a resistance of a definite value.

3. A method for controlling alternating-current motors with revolving magnetic field having their induced circuits connected with the terminals of a transformer with single windings, consisting of dividing the winding of the transformer into sections which are successively short-circuited on a resistance of a definite value.

4. A method for controlling alternating-current motors with revolving magnetic field having their induced circuits connected with the terminals of a transformer with single windings, consisting of dividing the winding of the transformer into sections which are progressively short-circuited on a resistance of a definite value.

5. A method for controlling alternating-current motors with revolving magnetic field, the induced circuits of which are connected with the terminals of a transformer having single windings, consisting of short-circuiting the sections of the winding on resistances the value of which is either zero or finite.

6. A method of starting and regulating the angular speed of motors with magnetic rotating field the circuits of the armature of which are connected to the terminals of transformers having single windings, consisting of short-circuiting a gradually-increasing number of sections of the single windings with resistances the value of which is either zero or finite, substantially as described.

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

PAUL JACQUES MATHURIN GIRAULT.

Witnesses:
HENRY SCHWAB,
EDWARD P. MACLEAN.