No. 745,957. PATENTED DEC. 1, 1903.

A. CHURCHWARD.

ALTERNATING CURRENT MOTOR.

APPLICATION FILED APR. 27, 1903.

NO MODEL.

Fig. 1.

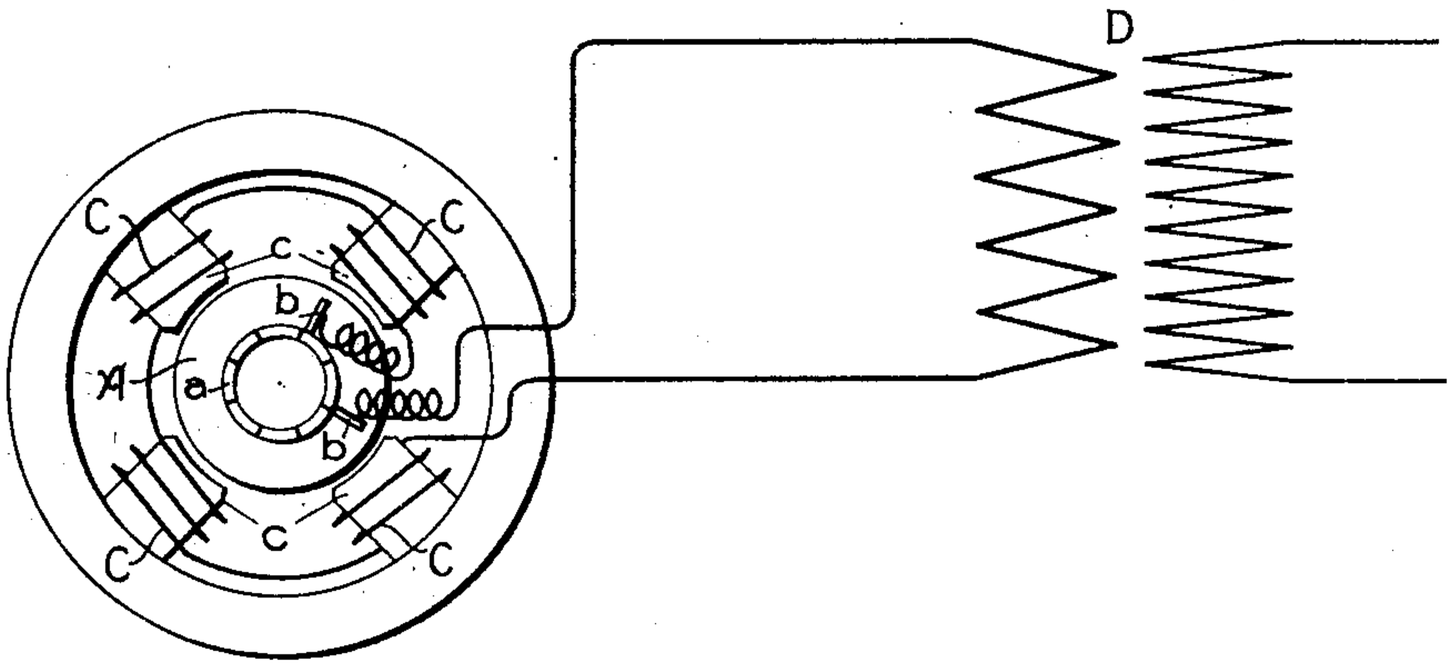


Fig. 2.

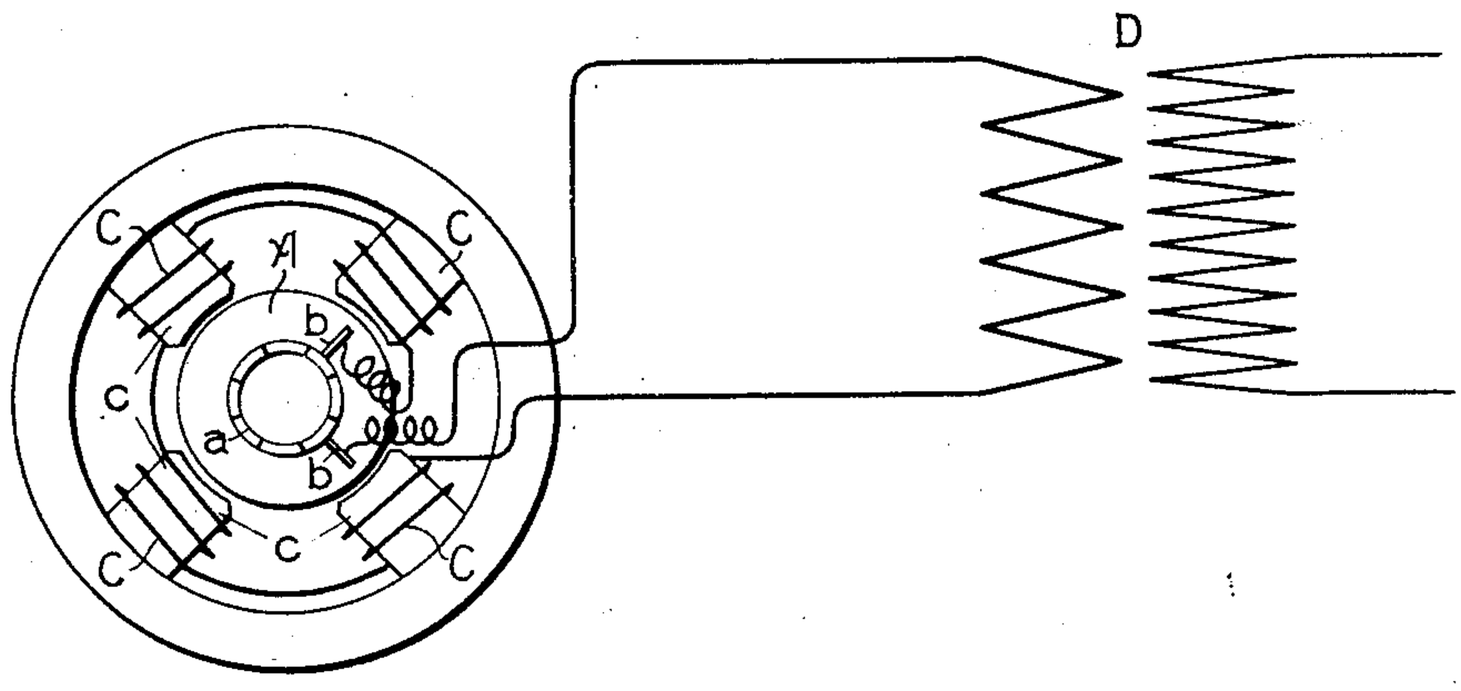
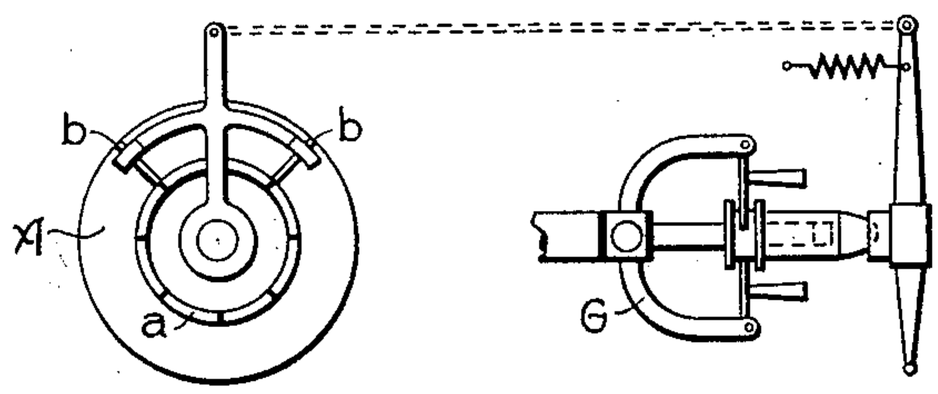


Fig. 3.



Witnesses.
Harry A. Tilden
Drew Oxford

Inventor.
Alexander Churchward
by Albert G. Davis
Atty.

No. 745,957. Patented December 1, 1903.

UNITED STATES PATENT OFFICE.

ALEXANDER CHURCHWARD, OF NEW YORK, N. Y.

ALTERNATING-CURRENT MOTOR.

SPECIFICATION forming part of Letters Patent No. 745,957, dated December 1, 1903.

Original application filed March 29, 1897, Serial No. 629,853. Divided and this application filed April 27, 1903. Serial No. 154,377. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER CHURCHWARD, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Alternating-Current Motors, of which the following is a specification.

My invention relates to alternating-current motors of the type in which the armature has any usual direct or continuous current-winding and commutator and is fed with single-phase alternating currents. Such machines, as is well known, will start and develop power, but are ordinarily inefficient and do not possess sufficient starting torque. When the motor is starting and running at low speeds, there are in the armature eddy-current losses, self-induction, and losses due to hysteresis, which all tend to reduce the useful voltage by increasing the self-induction in the motor-circuit. Consequently sufficient current may not pass to give a good starting torque. The usual method of overcoming this difficulty is to use a motor which is unnecessarily large for the service required of it when running at speed or else to construct it so as to have an abnormally small self-induction in order to allow sufficient current to pass at starting to give large torque, in which case it is inefficient when running at speed.

My present invention consists, essentially, in a novel way of starting this class of motors by adjusting the commutator devices during the starting operation to position where the machine will oppose a less self-induction to the alternating currents, thereby permitting a stronger current to pass, and after the armature has attained speed adjusting the said commutating devices back to their normal position.

My invention is especially useful in connection with alternating-current motors whose armature, having a direct or continuous current-winding and commutator therefor for starting purposes, is operated in series with a field-coil, the alternating current being fed to the machine in such way that when the armature revolves at synchronous speed the currents flow as continuous currents in the armature, being rectified by the commutator used in starting, as desired, while they flow in the field as an alternating current to rapidly reverse the polarity thereof and to produce in effect a rotary magnetic field.

In carrying out the invention the commutator-adjustment may be made by hand or by means of devices responsive to differences in speed of the machine—as, for instance, by any centrifugal governor connected to the commutator-brushes.

In an application filed by me March 29, 1897, Serial No. 629,853, I have illustrated and described an apparatus by which my invention can be carried out and have therein claimed the said apparatus. In the present application, which is filed as a division of the aforesaid application, I shall claim the method employed in carrying my invention into effect.

In the accompanying drawings, Figures 1 and 2, the two positions of the brushes are illustrated diagrammatically in connection with a four-pole machine, and Fig. 3 illustrates the application of a centrifugal governor to moving the brushes.

The armature A is wound with any desired system of coils, such as is employed on continuous or direct current dynamos or motors, but preferably with what is known as the "closed-circuit" winding, the commutator-cylinder for which is indicated at *a* and the commutator-brushes at *b*. The latter are preferably mounted on any desired construction of rocker, by which they may be adjusted circumferentially around the cylinder, and are insulated from one another, as usual in the art. The machine is supposed to have in this instance four field-magnets C, whose coils are preferably in series circuit with the armature. Alternating currents are fed to the machine from any desired source, as from a transformer, (diagrammatically indicated at D,) which by preference is adapted to supply a constant current. These currents in the starting operation flow in the armature and field as alternating currents; but when the machine attains synchronous speed they flow as continuous currents in the armature, but still as alternating currents in the field.

In the starting operation the self-induction of the machine is high, and insufficient current will pass to give a high starting torque.

To obviate this, I start the machine with the brushes set as in Fig. 1, in which they are shown slightly shifted from their normal positions, as shown in Fig. 2. This shifting of the brushes from their normal position has the effect of changing the relations of the poles of the field-magnets and armature, and thus decreasing the mutual magnetic reaction in the motor. This of course has the effect of reducing the self-induction of the motor. Other things being equal, of course the reduction of the magnetic reaction between the armature and the fields by shifting the brushes would have the effect of reducing the motor torque—as, for instance, in a direct-current motor—but since the motor under consideration is an alternating-current motor the reduction of the self-induction by the reduction of the magnetic reaction of the armature and fields is very great, so that the alternating current permitted to flow by such reduction is so far in excess of that which would flow were the magnetic reaction between the poles and armature allowed to remain normal that the increase in the torque resulting from this larger current far exceeds the slight decrease that would result under other conditions. Consequently the torque of the motor is greatly increased at starting by the slight shifting of the brushes, as shown in Fig. 1. When the machine reaches the synchronous speed, the self-induction is greatly lessened, as the current then flows as a continuous current in the armature. When the machine has reached the synchronous speed or as it runs up to such speed, the brushes are turned to their normal position for synchronous running, as indicated in Fig. 2. The adjustment may be made by hand or automatically. The latter manner of adjustment is indicated in Fig. 3, where I show a centrifugal governor G, connected to the rocker carrying the brushes. When the machine is at rest, the governor holds the brushes in the position shown in Fig. 1, but is adjusted to hold them in the position shown in Fig. 2 when turning at the synchronous speed. It is obvious that the invention may be used, if desired, in connection with any desired means for keeping or maintaining the machine at synchronous speed. The centrifugal governor is connected with the armature in any desired way, so as to revolve at the same speed as the armature.

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

1. The herein-described method of starting single-phase alternating-current motors having when operated at speed a continuous or direct current armature system and commutator therefor, consisting in feeding alternating currents to said commutator and armature, with the commutating devices adjusted to a position to give low self-induction in the armature-circuit under the action of the alternating currents at low speeds, and after the machine has attained running speed, adjusting the said devices to normal position.

2. In a series-wound alternating-current motor having a continuous or direct current armature and commutator, the herein-described method of reducing the self-induction of the motor and obtaining increased torque at starting, consisting in starting the machine with the commutator adjusted away from normal position, as and for the purpose described.

3. The herein-described method of starting a single-phase alternating-current motor having a continuous or direct current armature and commutator, which consists in reducing the magnetic reaction between the armature and the field at starting.

4. The herein-described method of operating a single-phase alternating-current motor having a continuous or direct current armature and commutator, which consists in reducing the magnetic reaction between the fields and armature at starting and then increasing such reaction after the machine has attained substantially running speed.

In witness whereof I have hereunto set my hand this 15th day of April, 1903.

ALEXANDER CHURCHWARD.

Witnesses:

L. C. FOSS,

C. D. REED.