

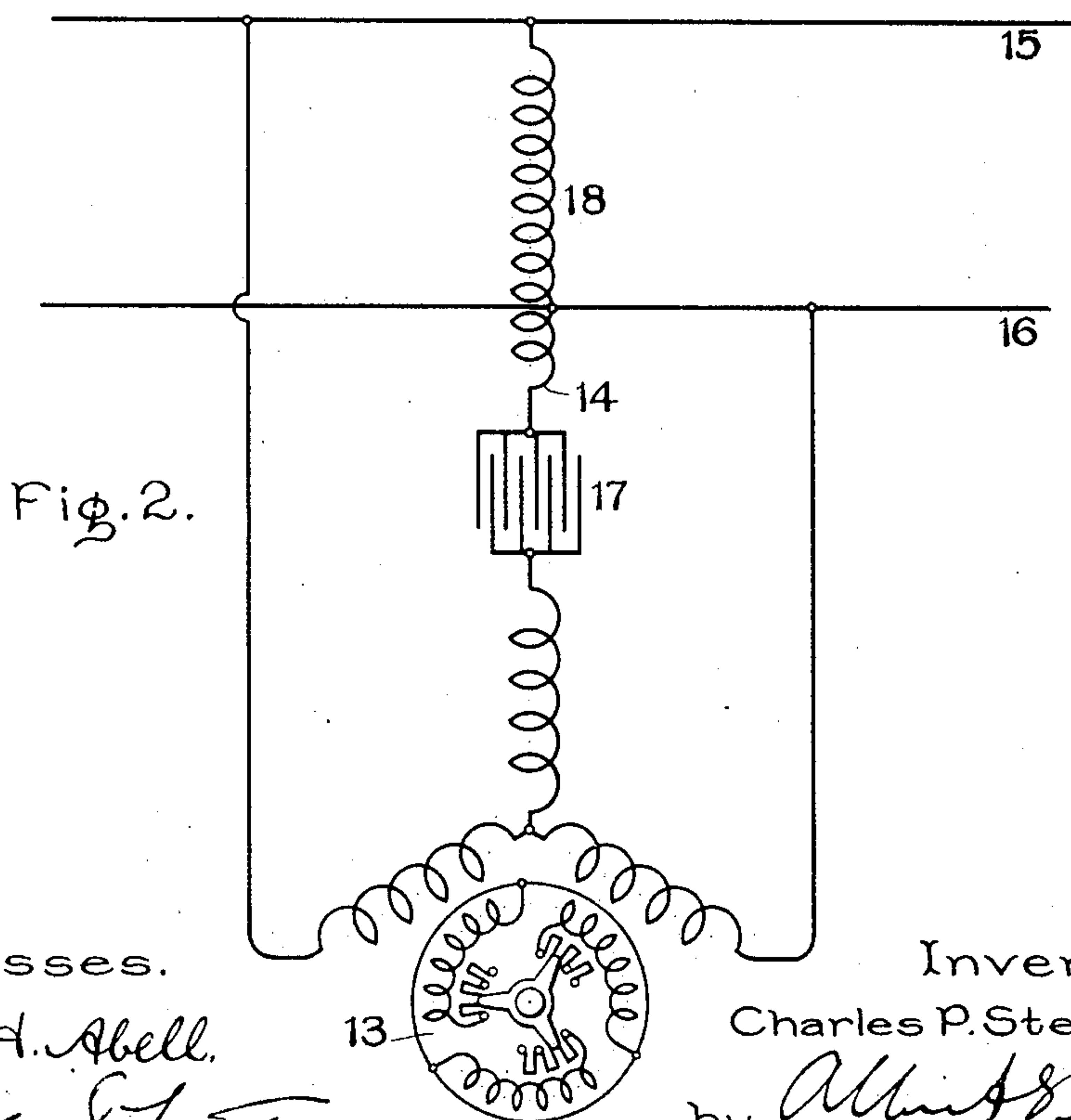
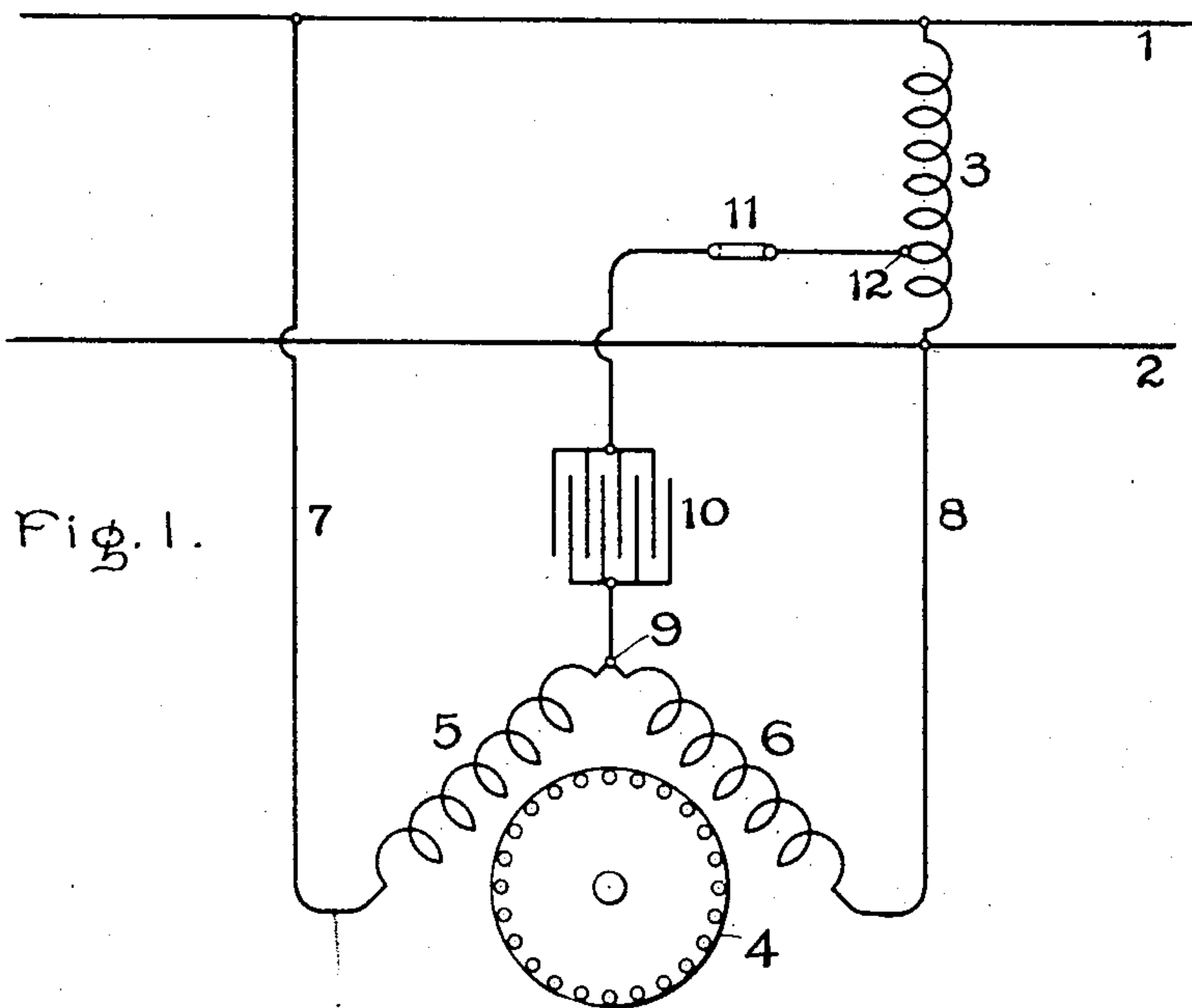
No. 687,078.

Patented Nov. 19, 1901.

C. P. STEINMETZ.  
ALTERNATING CURRENT SYSTEM.

(Application filed May 26, 1900.)

(No Model.)



Witnesses.  
Arthur H. Abell.  
Alexander S. Lunt.

Inventor.  
Charles P. Steinmetz.  
by *Alvin S. Davis*  
Atty.

# UNITED STATES PATENT OFFICE.

CHARLES P. STEINMETZ, OF SCHENECTADY, NEW YORK, ASSIGNOR TO  
GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## ALTERNATING-CURRENT SYSTEM.

SPECIFICATION forming part of Letters Patent No. 687,078, dated November 19, 1901.

Application filed May 26, 1900. Serial No. 18,023. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES P. STEINMETZ, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Alternating-Current Systems, (Case No. 1,227,) of which the following is a specification.

My invention relates to a means for starting alternating-current motors.

In most single-phase motor-starting devices the torque is a minimum at starting, but with increasing speed is increased by the superposition of the torque produced by the armature reaction of the motor. With increase in speed the torque produced by the armature reaction of the motor gradually preponderates over the torque, due to the impressed field of the motor, until the motor-field becomes more uniform than the impressed field of the starting device, whereupon the starting device should be cut out of circuit. For purposes of comparison it is therefore necessary to compare motor-starting devices only with respect to the torque which they produce at the moment of starting. In some cases the phase displacement for starting is produced through the agency of self-induction in series with a main or mains. When a starting device of this character is applied to a motor with quarter-phase windings, I have found that it is impossible to obtain a symmetrical quarter-phase system for starting the motor, whereby the starting torque is not as large as would otherwise be the case. I have, however, discovered that by the use of a condenser or some other device possessing the effect of capacity I may so adjust the impressing-circuits of the starting device as to produce electromotive forces equal in value to each other and displaced in phase by ninety degrees, thereby securing a marked increase in starting torque. It is not to be understood, however, that my invention is limited to use in this relation.

Embodiments of my invention are herein-after disclosed in connection with the accompanying drawings, the points of novelty of the invention being set forth in the claims appended hereto.

Figure 1 represents a quarter-phase start-

ing device, and Fig. 2 a three-phase starting device.

In Fig. 1 the lines 1 2 represent single-phase mains, across which is connected a compensator 3. In place, however, of a compensator I may, if desired, employ the secondary winding of a transformer. A motor having a squirrel-cage armature 4 and quarter-phase exciting-winding 5 6 is connected by leads 7 8 to the mains 1 2. The common point 9 between the windings 5 6 is connected, through a condenser 10 and a switch 11, to an intermediate point 12 in the length of the compensator 3. By this arrangement it is possible to produce a symmetrical quarter-phase system of electromotive forces at the terminals of the inducing-windings of the motor. In cases such as shown in Fig. 1, where the armature is of the squirrel-cage type, and therefore of low resistance, it is necessary that the connection to the compensator should be made at a point between its ends; but where the armature is provided with means for inserting resistance in its circuits—as, for example, as shown in the armature 13 in Fig. 2—the point of connection to the compensator 3 may be made to an extension of the compensator-winding corresponding to the extension indicated at 14 in Fig. 2. Fig. 2 differs from Fig. 1 in that it shows the application of the starting device to a motor having a three-phase inducing-winding, two of the terminals of which are connected to the mains 15 and 16 and the third, through a condenser 17, to the extremity of the extension 14 of the compensator 18.

The character of the motor-armature is of much importance as regards the starting torque, armatures of low resistance, such as those of the squirrel-cage type, giving rise to a comparatively small starting torque, while those with rheostatic control, such as shown at 13, in which resistance may be inserted at starting, enables the starting torque to be largely increased. Upon the value of the armature resistance as determined by its construction, as before specified, depends to a large extent the adjustment of the multi-phase starting device. To such an extent is this true that if a low-resistance armature, which may, for example, be of the squirrel-



cage type, is employed, as shown in Fig. 1, it is impossible to produce a quarter-phase system of electromotive forces except the terminals of the motor be connected across the mains and to some intermediate point in the compensator or secondary winding, if such be employed, while if an armature with rheostatic control for inserting resistance in circuit therewith is used one of the terminals of the motor may be connected to the compensator or secondary either between its connection with the mains or outside to an extension of the compensator, as indicated at 14 in Fig. 2.

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

1. The combination of a source of current, a number of conductors greater than two extending respectively from non-equipotential points thereon, a device possessing the effect of capacity in series with one of said conductors, and a multiphase motor connected to said conductors.

2. The combination of a source of current, a number of conductors greater than two extending respectively from non-equipotential

points thereon, a device possessing the effect of capacity in series with one of said conductors, a multiphase motor connected to said conductors, and means for varying the resistance of the induced member of the motor.

3. The combination of a source of single-phase current, three conductors extending therefrom and maintained thereby at respectively different potentials, a condenser in series with one of said conductors, and a motor with a multiphase winding connected to said conductors.

4. The combination of a source of single-phase current, three conductors extending therefrom and maintained thereby at respectively different potentials, a device possessing the effect of capacity in series with one of said conductors, and a motor with a multiphase winding connected to said conductors.

In witness whereof I have hereunto set my hand this 23d day of May, 1900.

CHARLES P. STEINMETZ.

Witnesses:

BENJAMIN B. HULL,  
MABEL E. JACOBSON.