(No Model.) 2 Sheets—Sheet 1.

C. J. VAN DEPOELE.

ALTERNATE CURRENT INDUCTION MOTOR.

No. 413,986. Patented Oct. 29, 1889.

Fig. 1.

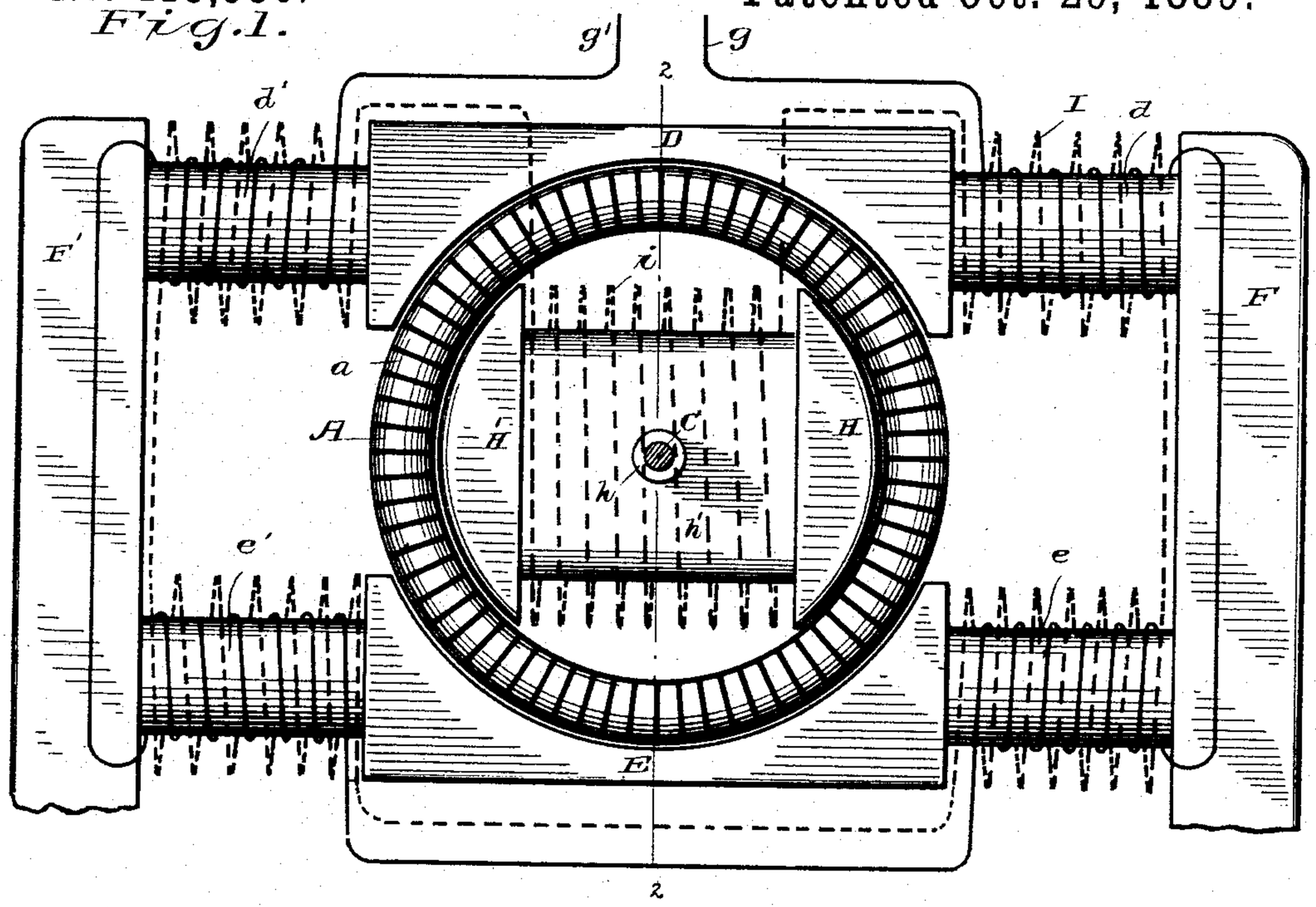
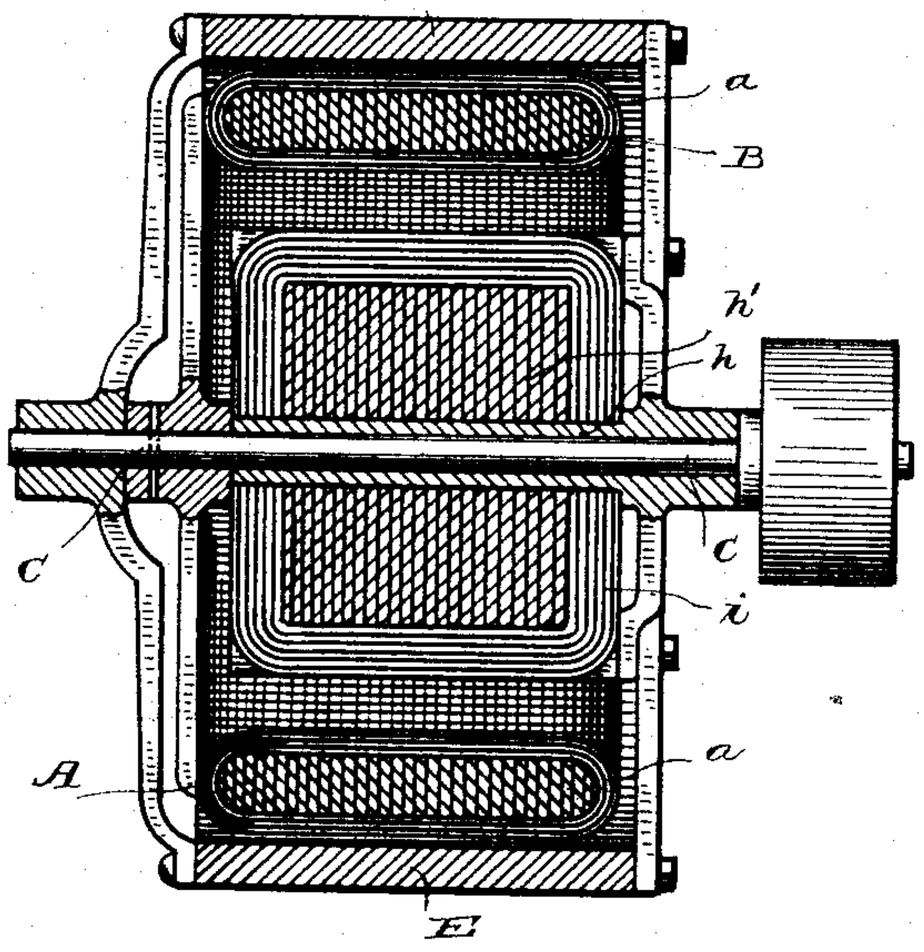


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

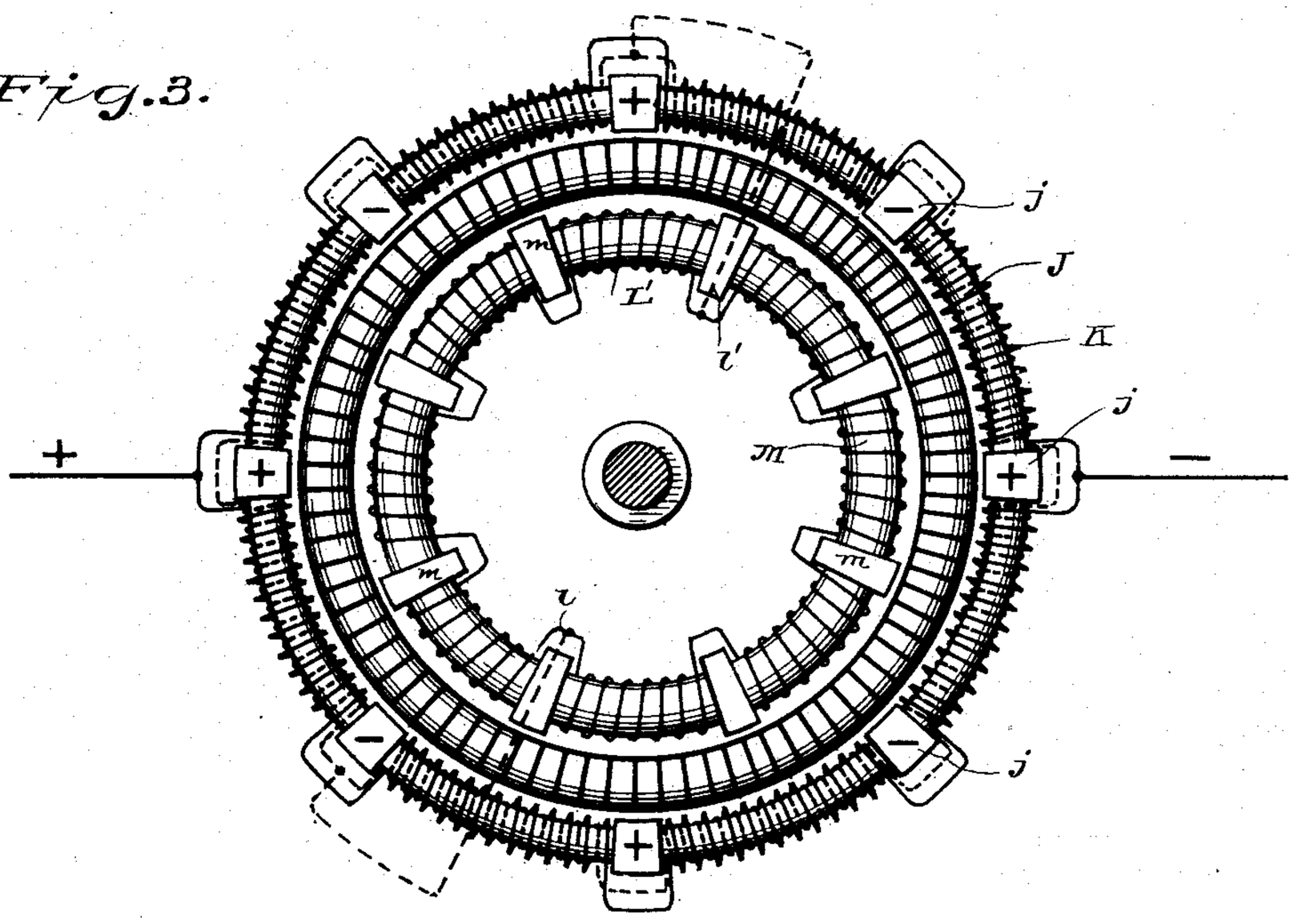
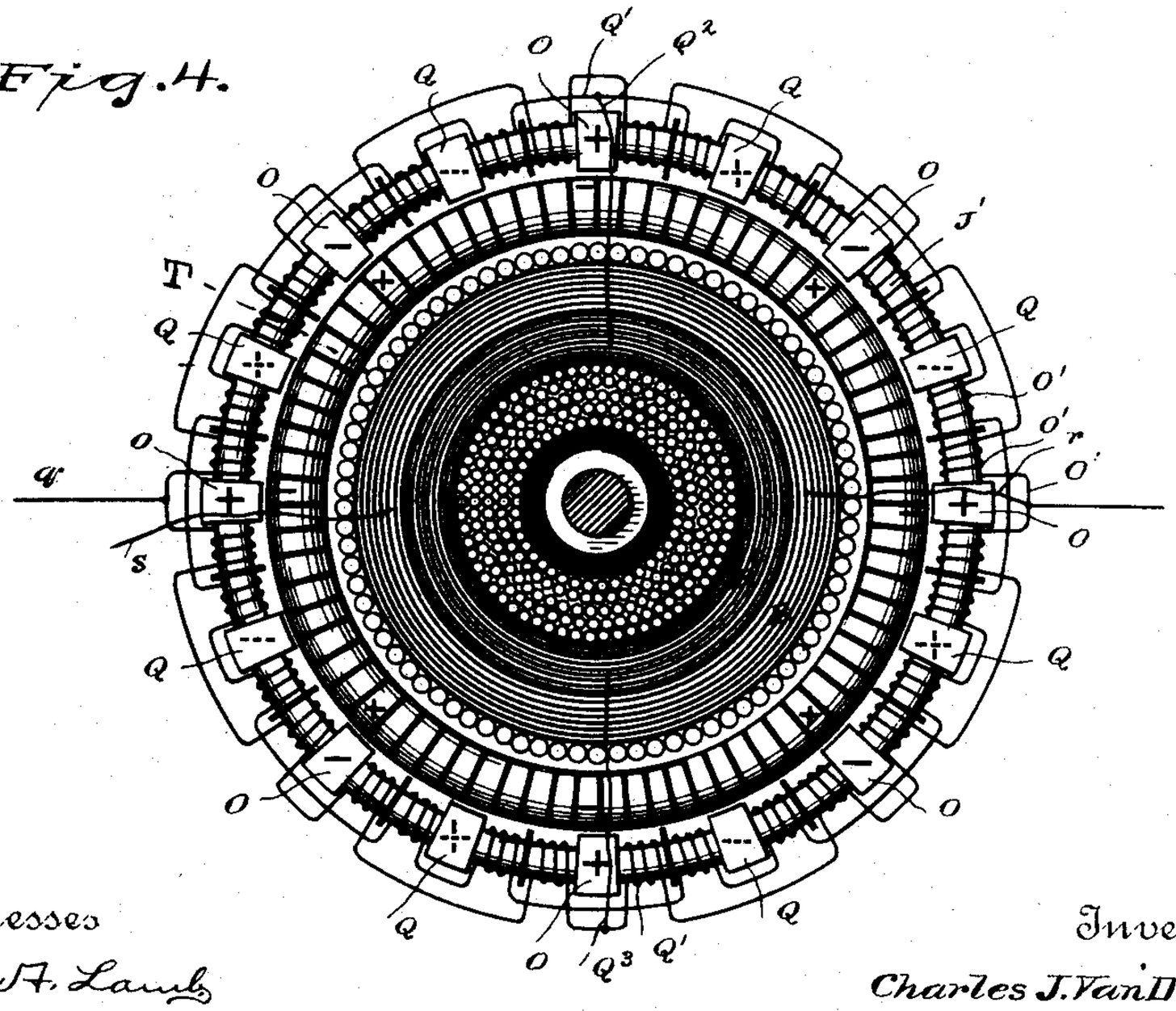


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF LYNN, MASSACHUSETTS.

ALTERNATE-CURRENT INDUCTION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 413,986, dated October 29, 1889.

Original application filed May 4, 1889, Serial No. 309,593. Divided and this application filed July 29, 1889. Serial No. 319,038.
(No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Alternate-Current Induction-Motors, of which the following is a description, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon.

This application is a division of Case Serial No. 309,593, filed May 4, 1889.

My invention relates to improvements in electro-dynamic motors of the class in which alternating, intermittent, or pulsating electric currents are employed to produce rotation of the armature.

In previous applications for Letters Patent I have shown and described the elementary form of alternate-current motor, comprising an iron disk, an inducing system over said disk for establishing poles therein, and a field-magnet for reacting upon said poles to produce rotation. I have also shown a system in which an armature having one or more closed circuits was magnetized by a large induction-coil surrounding said armature, the poles so established in the armature being reacted upon by a suitable field-magnet exterior to the induction-coil, said induction-coil and field-magnet being supplied with alternating or intermittent currents from the main source.

In another application a motor is described in which the principal features of the previous case are retained; but instead of energizing the induction-coil from the main supply-circuit the said induction-coil or a circuit in connection therewith is arranged in inductive relation to the main field-magnet winding, so that but a single supply-circuit was required, and the currents passing in the main field-magnet coils only will produce secondary currents in the induction system, which, being arranged in inductive relation to the armature, would produce tertiary currents therein serving to magnetize the same.

In the present instance I employ an armature having one or more closed circuits upon a laminated iron core, and said armature is polarized by currents induced within the said closed circuit by adjacent magnetic poles. The exterior enveloping induction system shown and described in the said prior application is in this case dispensed with and a plurality of sets of polar extensions provided, all in proximity to the said armature, and the conductors and connections upon the field-magnet system are so arranged that alternate polar extensions will be magnetized by the main supply-current flowing through proper conductors upon a suitable core, and the remaining polar extensions are magnetized by conductors arranged in secondary relation to the main and, as they will be hereinafter referred to, the primary field-magnet conductors. It will thus be seen that only a single circuit in the machine is supplied with current from the source, the remaining or other effects being produced by induction.

The action of the machine is as follows: A primary phase of current rising in the main field-magnet coils will magnetize the polar extensions thereof, and the lines of force from said pole, passing through the armature-conductor in proximity thereto, will cause the flow or create secondary currents in said armature-conductor, which secondary currents will establish definite poles in the armature-core, said poles being of opposite sign to that of the polar extensions by which they were created. The same phase of primary current by which the armature-core was magnetized, as just described, will also produce secondary currents in the secondary field-magnet conductors, and as said primary phase dies in the primary circuit the secondary currents created thereby will bring the secondary pole-pieces to their maximum magnetic strength. This will occur substantially at the same time as the poles are produced in the armature-core by the secondary current, and, the secondary pole-pieces being in advance of the primary pole-pieces, the armature will be attracted thereto and will have a definite and powerful torque, whether in motion or prevented from moving by mechanical means. The effect of the primary pole-pieces upon the core is repeated by the secondary pole-pieces, so that the phases alternating in the

said pole-pieces each create a current in the armature-conductor, which current establishes a pole to be acted upon by the pole-piece in advance thereof.

The invention here referred to is capable of numerous modifications, some of which are illustrated in the accompanying drawings, the various details of which will be hereinafter pointed out and referred to in the appended claims.

Figure 1 is a view in elevation showing an electro-dynamic motor embodying my invention, certain of the parts being broken away for convenience of illustration, and the circuits of the machine being shown diagrammatically. Fig. 2 is a transverse sectional elevation on the line 2 2 of Fig. 1. Fig. 3 is a diagrammatic view of a motor embodying the invention, but differing from Fig. 1 in the number and dispositions of the poles of the inducing system. Fig. 4 is a diagrammatic view showing still another disposition of the poles of the two inducing systems.

As indicated in the drawings, the armature A of my improved motor is provided with a large number of closed circuits *a*, wound upon a suitably subdivided or laminated iron core B. The separate circuits *a* upon the armature-core may be formed of any desired size of conductor, and may have any desired number of convolutions from being in the form of a single copper ring to that of a large number of convolutions of fine wire, and the several closed circuits *a* may occupy more or less space upon the said core, as desired, with or without relation to the polar projections of field. The armature A is rotatively mounted upon a suitable shaft C, being connected thereto by a spider C′. The said armature is closely enveloped by the polar extensions D E, each of which, as indicated in Fig. 1, is connected with two cores of a duplex magnet, so that the polar extensions D E are each of opposite polarity. To one end of each pole-piece are secured cores *d e*, which are magnetically united by end pieces F of the frame of the machine. To the other extremity of the pole-pieces are secured cores *d′ e′*, magnetically united by end piece F. Magnetizing-conductors G are wound upon the cores *d d′ e e′*, and when traversed by currents of alternating polarity or intermittent or pulsating in character the magnetism in the pole-pieces D E will rise and fall or be reversed. The iron entering into the construction of the cores and pole-pieces, being laminated or subdivided, will permit the said field-magnets to respond to the reversals or changes in the supply-current with the desired degree of rapidity.

Under the influence of an alternating current the action of a field-magnet such as described arranged in inductive proximity to an armature having a number of closed circuits thereon would of itself have little or no effect, since the action of said field-magnets would be merely to create local currents in the closed circuits, which, though polarizing the armature-core, would accomplish nothing. By my present invention, however, the poles created in the armature-core by the inductive action of the field-magnets thereon are caused to produce rotation of said armature by a second set of polar extensions arranged to react upon said poles as the energy that created them dies down in the main field-magnets. Such an arrangement may take the form of a fixed magnet arranged upon the interior of the armature, as indicated in Figs. 1, 2, and 3, although the secondary field-magnet might be arranged at the sides of the armature or wholly upon the exterior thereof and in alternation with the poles of the main field-magnet, as indicated in Fig. 4.

As seen in Figs. 1 and 2, an electro-magnet provided with polar extensions H H′ is sustained within the armature A, the poles H H′ thereof being arranged in close proximity to the conductor upon the core of the armature. The said field-magnet may be mounted upon a sleeve *h*, through which passes the armature-shaft G, and said electro-magnet should be adjustable upon its bearings in order that the most favorable conditions may be secured. As indicated, the poles H H′ of the secondary magnet are placed at right angles to a line passing through the center of the polar extensions D E. The said pole-pieces H H′ are therefore in position to react upon poles established in the armature-core by the inductive action of the primary field-magnet poles thereon. Current from the source of supply enters the field-magnet circuit G at terminal *g*, then traverses the conductor upon the cores *d d′ e e′*, leaving by terminal *g′*. Said cores are also provided with a second conductor I, which is indicated in dotted lines. The secondary conductor I is wound in between the layers or convolutions of the primary conductor G, in any manner which will secure the desired inductive effect, and the said secondary conductor I is closed upon a number of coils *i*, which are wound upon and serve to magnetize the core *h′* and the secondary pole-pieces H H′. The step-by-step action by which the armature is alternately magnetized through the inductive action of one set of stationary pole-pieces and then attracted by the other will continue so long as currents of suitable character are furnished to the primary circuit of the machine. A slightly-different arrangement is seen in Fig. 3, where an annular field-magnet core J is shown, said core being, by way of illustration, provided with eight polar extensions, which, it will be noted, are marked to indicate alternating polarities. The eight polar extensions *j* may be of iron or they may simply consist of divisions between sections of winding, the poles in that case being consequent points upon the iron core J. Two separate windings K and L, the former in full and the latter in dotted lines, are seen

upon the core J, the winding K constituting the main primary circuit of the machine by which the pole-pieces *j* are energized, while the winding L is arranged in inductive proximity to the core J, and when said primary circuit K receives a primary current of alternating or intermittent character the rise and fall of each phase of current will cause the flow of corresponding secondary currents in the secondary winding L, which, during the time that the primary pole-pieces have the least power, will flow by way of conductors *l l'* to the conductors L' upon a second annular core M, arranged upon the interior of the armature A and provided with polar extensions *m* in inductive relation to the said armature A. The primary polar extensions *j* being arranged in alternation with the secondary polar extensions *m*, and the armature A being rotatively arranged between the said sets of poles, if now the said poles are energized in alternation—that is, first one set and then the other—the inductive effect of one set of poles will create currents in the closed circuits upon the armature-core, which will polarize said armature and cause it to be attracted toward the other set of poles, which are then energized for that purpose. In this manner a rapid step-by-step movement is imparted to the armature, which, under the influence of currents of even moderately rapid phase, becomes practically continuous.

It is not essential that the two sets of poles be arranged one upon the interior and the other upon the exterior of the armature. An arrangement in which said sets of poles are arranged in alternation is seen in Fig. 4. Upon the core J' two sets of polar extensions O Q are formed or placed, and between said polar extensions two sets O' Q' of magnetizing-coils are wound, one set O' being in circuit with the main supply-conductor *q* and the other set in circuit with an inductional system R, and by which the other set of polar extensions are magnetized. The armature A is rotatively mounted with its periphery as near to the polar extensions O Q as is consistent with mechanical safety. The two sets of field-magnet poles might be magnetized in many different ways. A desirable arrangement is shown in Fig. 4, where an inductional apparatus is placed within the armature for convenience only, as it might equally well be located upon some other part of the machine. The said secondary inducing system is provided partly for the purpose of changing the direction of the phases of the secondary current and partly in order to retard and to deliver a magnetizing-current at such time as to produce active secondary poles in proper position between the inactive primary poles to react upon the poles produced in the armature by the inductive effect of the primary current thereon.

The primary circuit R of the inductive system may be either in series, in multiple arc, or in derivation from the primary circuit O'. With either arrangement the primary current will pass therethrough simultaneously with its passage through the primary field-magnet coils O'. As the said primary current falls secondary currents will rise in the secondary coils R' of the induction system, which said currents, flowing thence to the secondary coils Q' upon the field-magnet core J', will magnetize the secondary poles Q, which will then react upon the poles established in the core of the armature by the inductive effect of the primary field-magnet poles thereof.

The induction system is provided with a core S, composed of subdivided iron, shown in the form of small iron rods or wires. The inducting system is further strengthened and protected by an exterior envelope T, of magnetic material, as small iron rods or wires.

In the present instance the primary conductor R is connected with conductor O' in series multiple by conductor *r*, and a conductor *s* extends from the opposite portion of conductor R to the exterior of the machine and to line. It will be understood that the primary inducing-conductor may be connected in any desired relation to the main field-magnet coils. In like manner the secondary conductor R' is connected to the secondary field-magnet O' by conductors Q^2 Q^3.

The results hereinbefore described can be obtained by mechanisms embodying the principles set forth, but arranged in various different ways mechanically.

This application being a division, any matters not covered by the claims hereto annexed will continue to form part of the parent case.

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

1. An electro-dynamic motor for use with alternating or intermittent currents, comprising an armature wound with closed-circuit conductors, an exterior field-magnet system acting to polarize said armature-core, and a stationary secondary field-magnet system within the armature for reacting upon the poles induced by the exterior field-magnet and then in turn creating other poles to be reacted upon by the exterior field-magnet, and vice versa.

2. An electro-dynamic motor comprising a rotating armature provided with one or more closed circuits upon its armature-core, an interior stationary field-magnet system arranged to polarize the armature-core by induction, and an exterior field-magnet system reacting upon the poles produced by the interior magnet, and itself in turn establishing other poles in the armature to be reacted upon by the interior magnet, substantially as described.

3. An electro-dynamic motor comprising an armature having an iron core and a closed circuit or circuits thereon, an exterior inducing system comprising field-magnet poles in inductive relation to the armature-conductor,

an interior secondary field-magnet, the polar extensions of which are between the poles of the main field-magnet, magnetizing-coils upon said secondary field-magnet, and a secondary winding in closed circuit with the said secondary field-magnet coils and in inductive relation to the coils of the primary field-magnet.

4. An electro-dynamic motor comprising an armature wound with closed-circuit conductors, an exterior field-magnet system acting to polarize said armature-core, a secondary field-magnet within the armature for reacting upon the poles induced by the exterior field-magnet and then in turn creating other poles to be reacted upon by the exterior field-magnet, and vice versa, a single external source of current energizing one of the field-magnets, and coils in secondary relation to said field-magnet and connected to magnetizing-coils upon the other field-magnet.

In testimony whereof I hereto affix my signature in presence of two witnesses.

CHARLES J. VAN DEPOELE.

Witnesses:

FRANKLAND JANNUS,

CHAS. L. STURTEVANT.