(No Model.)

R. LUNDELL.

DYNAMO ELECTRIC MACHINE.

No. 571,310. Patented Nov. 10, 1896.

Fig. 1.

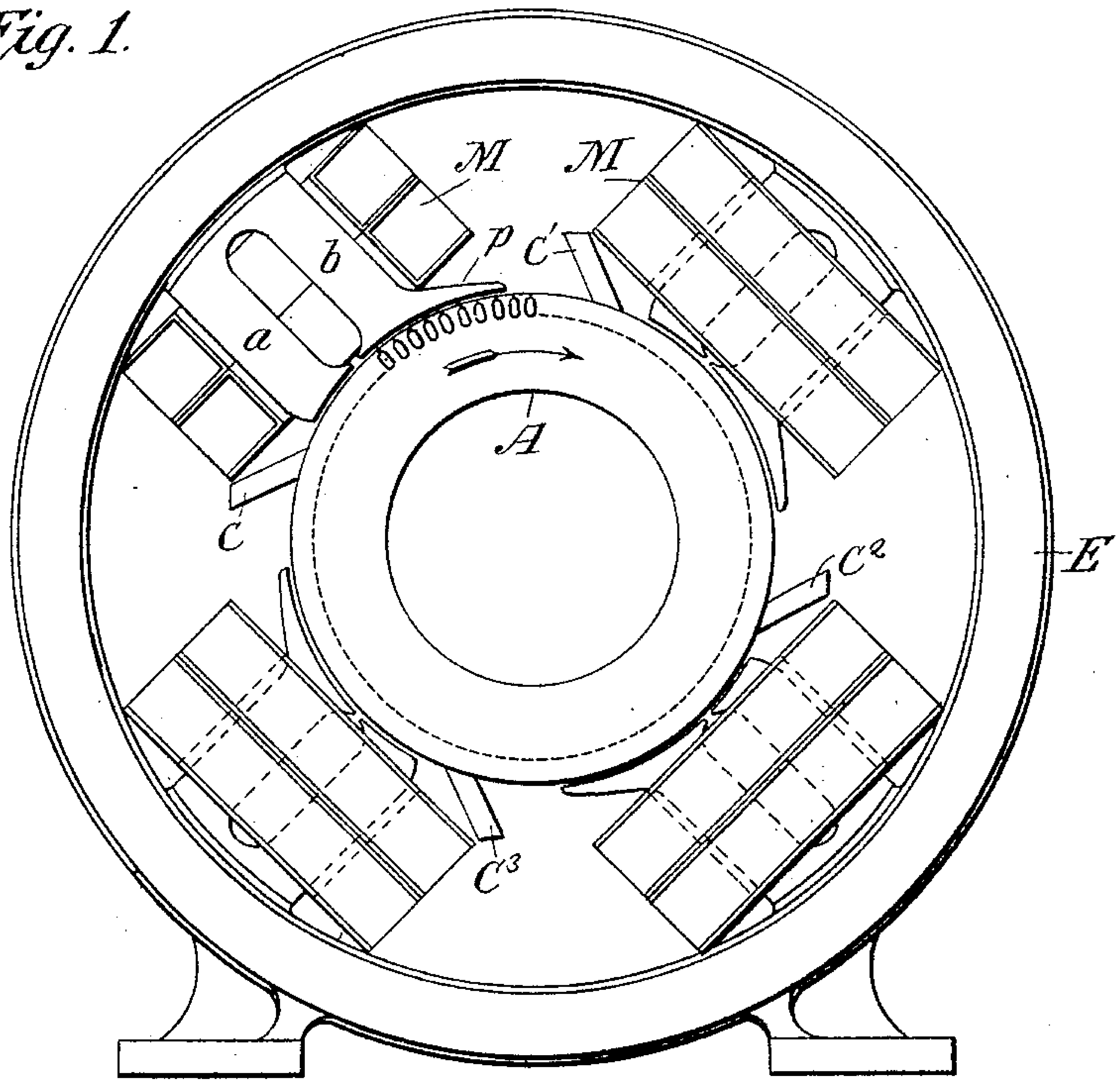


Fig. 3.

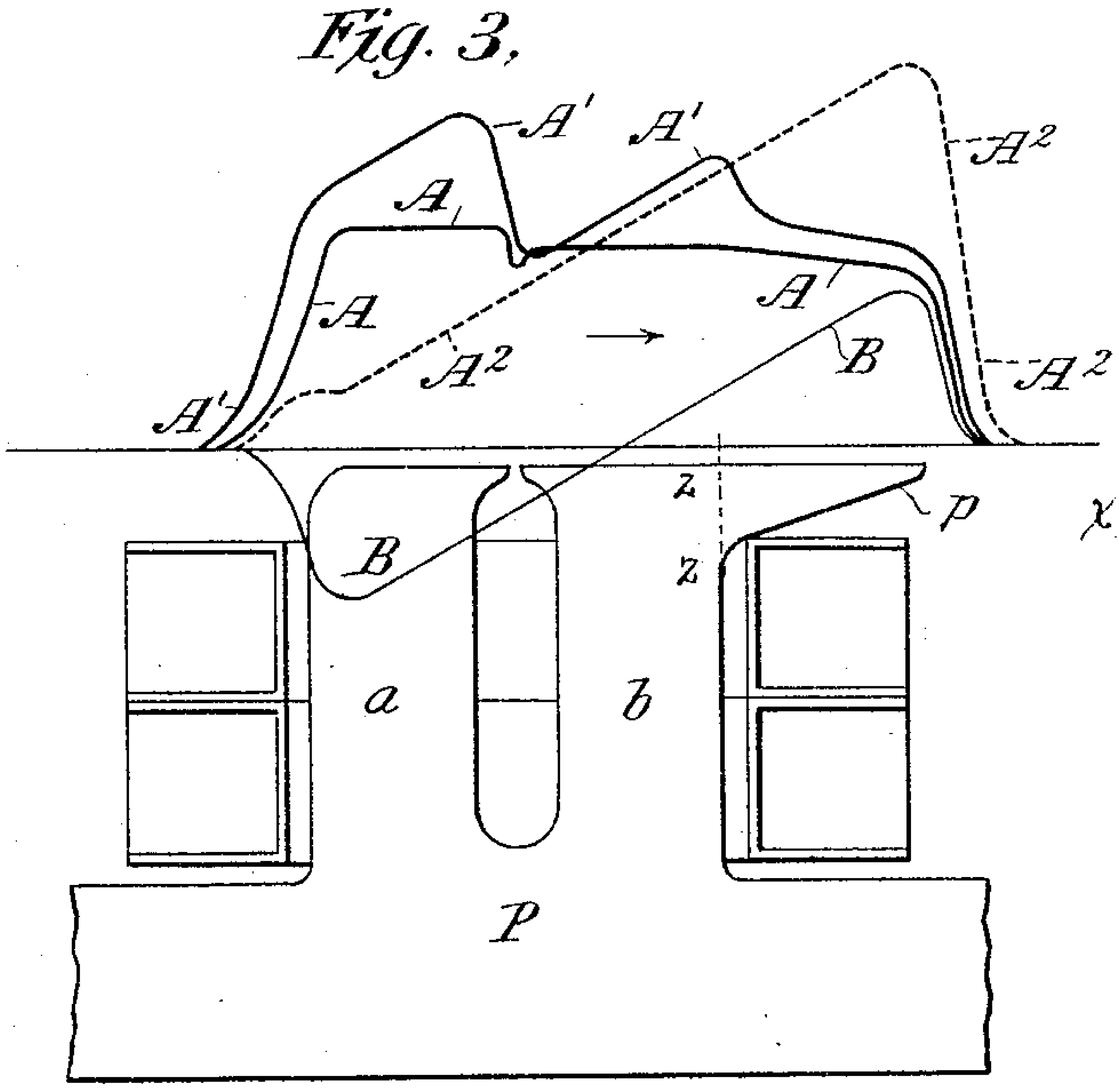
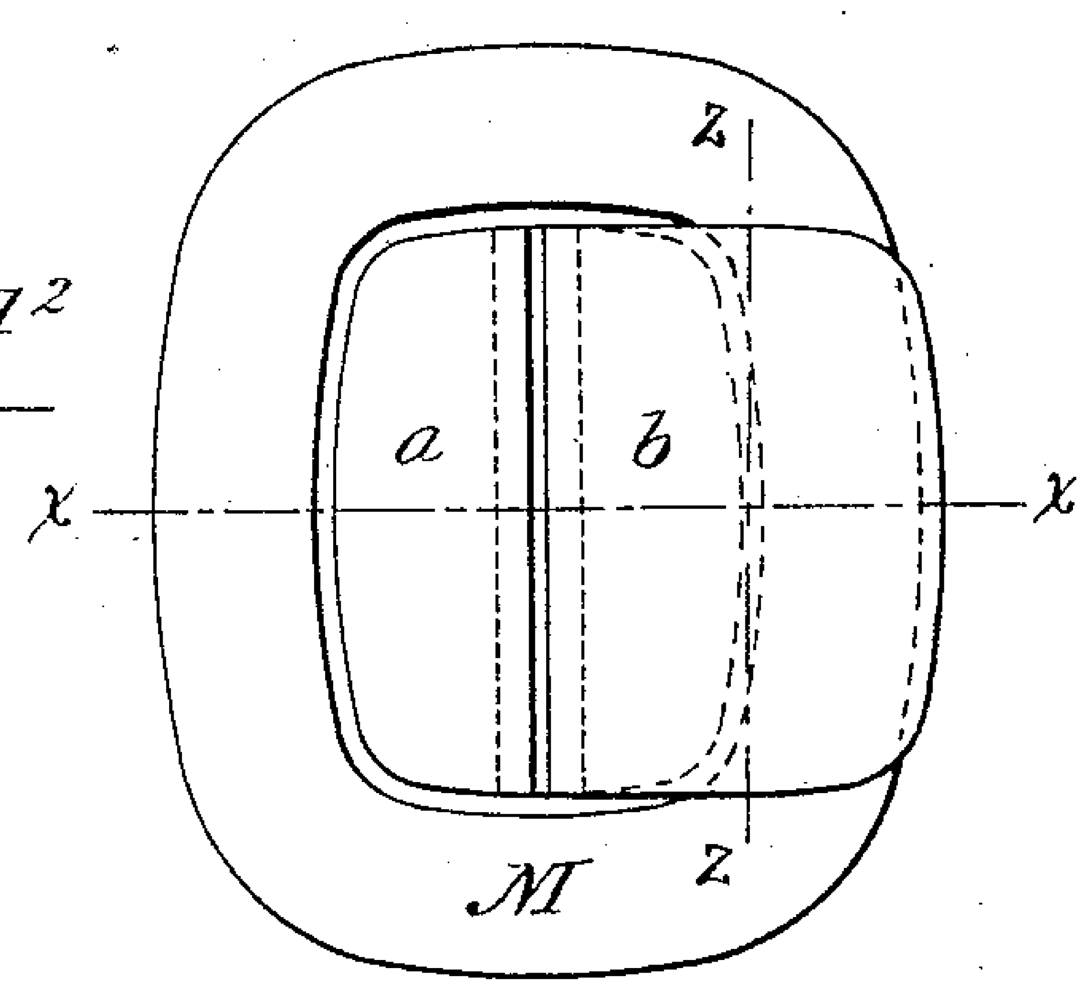


Fig. 2,



Witnesses
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UNITED STATES PATENT OFFICE.

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DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 571,310, dated November 10, 1896.

Application filed October 7, 1895. Serial No. 564,847. (No model.)

To all whom it may concern:

Be it known that I, ROBERT LUNDELL, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have made a new and useful invention in Dynamo-Electric Machines, of which the following is a specification.

My invention is directed particularly to improvements in direct-current dynamo-electric machines, and its object is to prevent the shifting or distortion of the magnetic fluid in machines of this type when working under full load.

It is well known by those skilled in the art of designing and using such dynamo-electric machines that the ampere-turns due to the armature-currents have a demagnetizing and cross-magnetizing effect upon the field-poles thereof. In other words, the armature ampere-turns which lie between the double angle of lead have a demagnetizing effect upon the magnetic circuits and the armature ampere-turns which lie directly under the poles have a cross-magnetizing effect or a tendency to weaken the pole strength at that pole corner where the commutation takes place and to increase the pole strength at the opposite pole corner. This demagnetizing effect can readily be compensated for by compounding, but the cross-magnetizing or distorting effect is not so easily overcome. Various methods have heretofore been suggested by those skilled in the art for overcoming this objectionable feature, and the present invention is directed to a simple method of and means for accomplishing this object.

My invention will be fully understood by referring to the accompanying drawings, in which—

Figure 1 illustrates in side elevational view a well-known form of compound-wound four-pole dynamo-electric machine embodying my improvement in the structure of the field pole-pieces. Fig. 2 is an end view of one of the field-magnet coils and my improved field-magnet poles surrounded thereby. Fig. 3 is an enlarged sectional view taken on the line $x\,x$, Fig. 2, a diagrammatic view of various magnetic conditions being also illustrated in full and dotted lines at the top of said figure.

A represents the armature of the machine, which in this instance is designed to rotate from left to right.

M represents the field-magnet coils of a well-known form of compound-wound field.

The commutator-brushes, four in number, are represented by the letters C, C', C^2, and C^3, Fig. 1.

The field-magnet poles, or rather the field-magnet cores, are divided, as shown, into two distinct parts a and b, practically of the same cross-section. The pole-face of the part a has an area only slightly larger than a cross-section of said part, whereas the pole-face of the part b has an area of at least twice the same cross-section. The part b, as will be observed, is provided with a wedge-shaped polar projection p, extending laterally from the dotted line $z\,z$, (shown in Figs. 2 and 3,) and is so proportioned that it covers about the same area as the pole-face of the part a, its thickest part, having a cross-section at its base on the section-line $z\,z$ about equal to one-half of the cross-section of b.

The material used for the field-magnet cores is cast-steel, although these cores may in some instances be constructed of sheet-iron punchings. The induction across the air-gap is such that the field-core b is saturated when the machine is working under a light load and supersaturated at full load. For example, if at light load the induction across the air-gap is seven thousand five hundred centimeter gram-seconds lines per square centimeter under the field-magnet core a and seven thousand per square centimeter under the field-magnet-core b it will be seen that the induction in b is about twice as high as in a. In other words, b is saturated, whereas a is far below saturation and capable of increasing the induction under its pole-face as the magnetizing force from the compound winding increases with the load.

At full load the magnetizing force upon the magnetic circuit through a is as follows: shunt ampere-turns + series ampere-turns on field-cores − armature ampere-turns between the double angle of lead − the armature ampere-turns that lie under the pole-face of b. The sum of these forces is such that the induction under the pole-face of *a* has increased by a predetermined amount. (See Fig. 3.)

The magnetizing forces acting upon the magnetic circuit through *b* at full load are as follows: shunt ampere-turns + series ampere-turns on the field-coils − armature ampere-turns between the double angle of lead + the armature ampere-turns that lie under the pole-face of the part *a*. The sum of these magnetic forces, although considerably greater than those acting upon the circuit through the part *a*, are unable to materially increase the induction from the pole-face of the part *b* on account of the high saturation of said part and its extended polar projection *p*. The inductive effect across the air-gap is represented diagrammatically in Fig. 3 by the heavy line A A A at no load and the heavy line A′ A′ A′ at full load. The fine line B B B represents diagrammatically the cross-magnetizing effect of the armature, and the dotted line A^2 A^2 A^2, parallel therewith, the resultant inductive effect across the air-gap at full load of a machine which is provided with solid pole-pieces of well-known form. This method of representing the inductive effects of the field-magnets diagrammatically by an irregular line A A A and the cross-magnetizing effects of the armature by a fine diagonal line B B and the resultant effect thereof by a dotted parallel diagonal line A^2 A^2 A^2 is fully explained in Volume 2 of *Practical Electrical Engineering*, a publication published by Biggs & Co., of Nos. 139 and 140 Salisbury Court, Fleet Street, E. C., London, England, and edited by Gisbert Knapp and other well-known electrical engineers, and reference is had to chapter XI, pp. 72 to 81, of said publication for the full explanation thereof.

The effect of my peculiar form of field-magnet pole with the polar projection *p* is illustrated upon this diagram by the full irregular line A′ A′ A′, thereby showing that the magnetic fringe or line of commutation between no load A A A and full load A′ A′ A′ varies but little. In other words, this diagram shows that with a field-magnet pole of well-known solid form of construction the magnetic fringe or line of commutation shifts between no load and full load to such an extent that a shifting of the commutator-brushes is required, while with my improvement this shifting of the line of commutation or magnetic fringe is scarcely appreciable, the magnetic effect of the polar projection *p* being such that the brushes may be allowed to remain constantly in one position for all loads.

If it should be required to run the generator in the opposite direction, it would of course in that event be necessary to reverse the direction of the field cores or poles.

I do not limit myself to the special structural arrangement herein shown and described for effecting the result sought, as I believe it is broadly new with me to increase the magnetic effect of a dynamo-electric machine in that portion of the magnetic field wherein the brushes are located by increasing the magnetic reluctance of the field-cores or pole-pieces thereof in the direction of rotation of the armature or rotary part in proportion to the work which the machine is called upon to perform and without the use of auxiliary coils and to utilize this effect for the prevention of sparking at the brushes, and my claims hereinafter made are therefore to be construed as of the most generic nature.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A dynamo-electric machine having its field cores or poles arranged with saturated and unsaturated portions as and for the purpose described.

2. A dynamo-electric machine having field-magnet cores or pole-pieces so divided and arranged that there is an increase in the magnetic reluctance in the direction of rotation of the armature or rotary part.

3. A dynamo-electric machine having field-magnet cores and pole-pieces so divided and arranged that the magnetic reluctance is caused to increase in the direction of rotation of the armature or rotary part.

4. Means for preventing the shifting of the magnetic field with increasing load in a dynamo-electric machine, consisting of field-cores or pole-pieces having low magnetic reluctance on the side where commutation takes place and high magnetic reluctance on the opposite side of the pole while the armature or rotary part rotates from the pole of low magnetic reluctance toward the pole of high magnetic reluctance.

5. In a dynamo-electric machine a field-magnet coil surrounding a field-magnet pole which is divided into two parts separated by an air-space, one of said parts having an inner field-pole surface of greater area than the other.

6. In a dynamo-electric machine a field-magnet coil surrounding two field-magnet poles separated from each other by an intervening air-space, one of said field-magnet poles having a wedge-shaped pole-piece, the inner face of which is of greater area than the inner face of the other pole-piece, substantially as described.

In testimony whereof I have hereunto subscribed my name this 5th day of October, 1895.

ROBERT LUNDELL.

Witnesses:
C. J. KINTNER,
M. M. ROBINSON.