(No Model.)

3 Sheets—Sheet 1.

C. E. SCRIBNER & E. P. WARNER.

PERFORATED POLE PIECE FOR DYNAMO ELECTRIC MACHINES.

No. 496,449. Patented May 2, 1893.

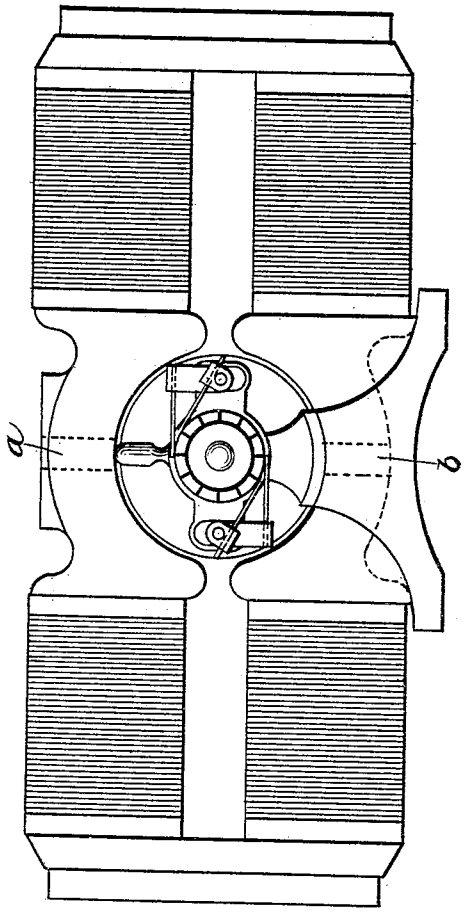

Fig. 1.

Witnesses.
Charles G. Hawley.
Ella Edler

Inventors:
Charles E. Scribner.
Ernest P. Warner
By George P. Barton
Attorney.

(No Model.)

3 Sheets—Sheet 2.

C. E. SCRIBNER & E. P. WARNER.

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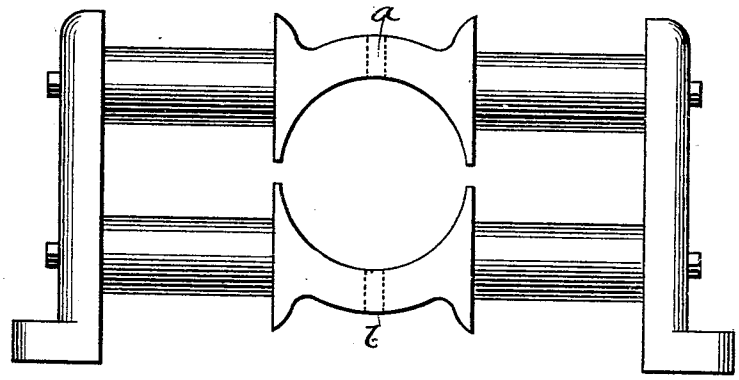

Fig. 2.

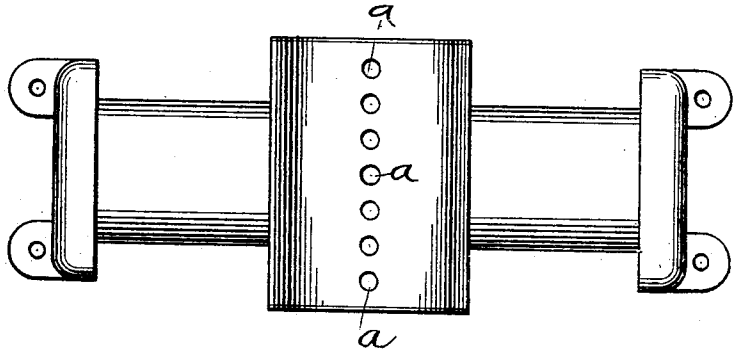

Fig. 3.

Witnesses.
Charles G. Hawley.
Geo. R. Parker.

Inventors.
Charles E. Scribner.
Ernest P. Warner.
By Burgess Barton
Attorney.

(No Model.)

3 Sheets—Sheet 3.

C. E. SCRIBNER & E. P. WARNER.

PERFORATED POLE PIECE FOR DYNAMO ELECTRIC MACHINES.

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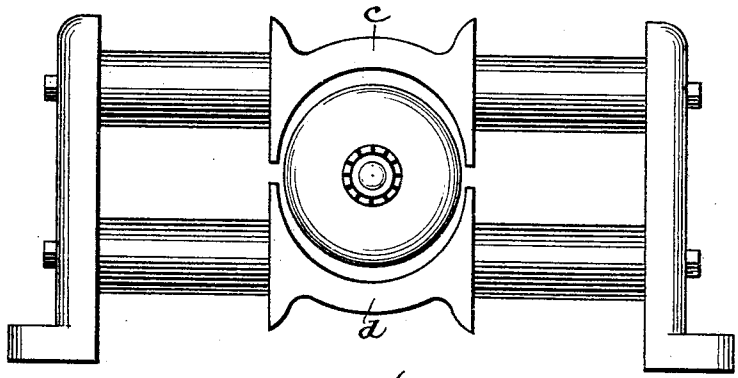

Fig. 4.

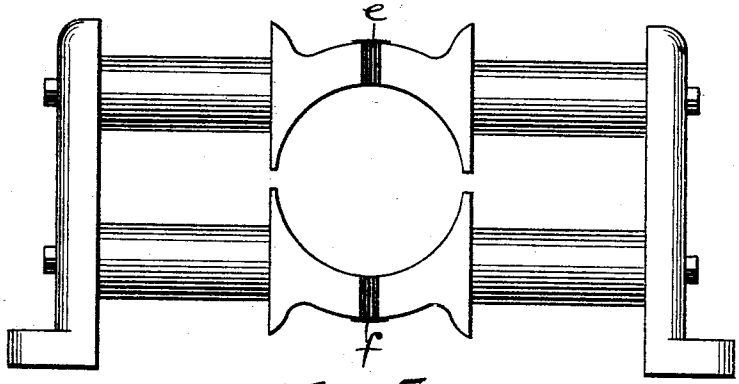

Fig. 5.

Witnesses.
Charles G. Hawley.
Geo. R. Parker.

Inventors.
Charles E. Scribner
Ernest P. Warner.
By Ferga & Barton
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER AND ERNEST P. WARNER, OF CHICAGO, ILLINOIS, ASSIGNORS TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

PERFORATED POLE-PIECE FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 496,449, dated May 2, 1893.

Application filed February 7, 1890. Serial No. 339,600. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. SCRIBNER and ERNEST P. WARNER, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Perforated Pole-Pieces for Dynamo-Electric Machines, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to dynamo electric machines and its object is to distribute the lines of force in such manner that the armature may be driven in either direction and the brushes shifted upon the commutator to vary the electro motive force of the machine to maintain the current strength uniform under a varying load. This we accomplish by the use of consequent pole pieces perforated across their centers or bored out eccentrically in such manner as to produce a field having the lines of force uniform as to strength and direction with respect to the coils of the armature rotating therein. When consequent pole pieces, as has been the case heretofore, have their faces concentric with the armature and without perforations at their centers the lines of force have been unevenly distributed and thus on account of this uneven distribution of the lines of force with respect to the coils of the armature as said coils are moving through different portions of the field it has not been practicable to construct a satisfactory right and left machine capable of regulation by shifting the brushes upon the commutator.

In Letters Patent No. 402,200, of April 30, 1889, salient pole pieces are shown insized or formed to cause such a distribution of the lines of force with relation to the armature that brushes may be shifted from one position to another, said distribution, however, being provided only through that portion of the field in which the coils are rotating, which coils are short circuited by the commutator collecting brushes for a machine whose armature can be rotated only in one direction; the distribution of the lines of force for this purpose cannot be secured by the various methods of cutting away the pole piece as shown in the said patent, since when the poles are insized for rotation in one direction the lines of force will not be properly distributed for rotation of the armature in the opposite direction.

In a Siemens or Gramme armature as ordinarily constructed for a dynamo machine the two halves of the armature are connected in multiple arc with respect to the external circuit being connected to those two halves at the segments of the commutator; a portion of the armature is short circuited at each of the commutator collectors; this portion which is short circuited has in its rotation the moment before being short circuited been included in the circuit of the half of the armature which would cause current to flow through it in one direction. At the moment of short circuiting this current must cease to flow and while still short circuited current must begin to flow in the opposite direction; at the moment of coming out of the short circuit, at which moment it is introduced into the other half of the armature, the current flowing should be exactly equal to that flowing in the half of the armature into which this portion but a moment before short circuited is now introduced. In order that the current shall have died out and come up to exactly the right strength during its passage from the one half to the other exactly the right time must be allowed this portion of the coil in its passage from one half to the other; this time is determined by the adjustment of the commutator brushes and segments. When the short circuited portion of the armature rotating at the same speed is cutting the same number of lines of force and the time of short circuiting remains the same then the current flowing in the short circuited portion at the instant of the breaking of the short circuit will always be the same. If the lines of force should be made stronger, the other things remaining the same, the current in the short circuited portion at the instant of short circuiting would be stronger than that of the half into which it is just introduced and an arc is formed between the brush and the segment of the commutator with which it has been in contact to short circuit the coil, this arc persisting during the continued revolution and resulting in a flash about the com-

mutator which extinguishes the lights. In case the current in the short circuited portion has not reached a strength equal to that of the half into which it is just introduced a bright burning spark is created which will, if permitted to continue, result in the destruction of the commutator and brushes. It is therefore evident that whatever the position of the brushes upon the commutator may be the same interval of short circuiting must be provided for, a constant speed maintained and uniform lines of force provided to be cut by the short circuited coil in order that a constant current may be maintained.

Our invention consists in producing in the field lines of force uniformly distributed as to generating or current producing effect throughout the arc or segment traversed by the coils of the armature opposite the faces of the different pole pieces whereby the machine is made capable of running in either direction and of being regulated under varying load to maintain constant current strength by shifting the brushes upon the commutator. This we accomplish by providing consequent pole pieces with perforations across the centers thereof in a line co-incident with a plane passing through the axis of the armature or in boring out said pole pieces as hereinafter described and providing brushes bearing upon the commutator segments in such a manner as to allow of the rotation of the armature in either direction.

Every dynamo must have its pole pieces specially constructed and adjusted as no two dynamos contain the same character of iron with respect to magnetism.

To adjust a dynamo so that its lines of force will be right with respect to the rotating armature in the different parts of the pole piece the dynamo is completed and the armature inserted and rotated before the special construction with respect to the formation of the pole pieces is effected. The dynamo is then connected in circuit with a resistance and its armature rotated at the speed at which it is designed to be run; the brushes are set at the practical maximum point of commutation, a point in advance of the point of maximum electro motive force and the resistance adjusted to bring the current of the dynamo to the point desired. With the brushes at a fixed position, the current of the right strength and the speed constant the lines of force cut by the short circuited portion of the armature are made right so that the short circuited portion of the armature will have the right current flowing in it at the moment the short circuit is broken by a primary adjustment of the winding of the field magnet coils. The number of ampère turns on the field are decreased if flashing of the commutator takes place on this initial starting of the machine and increased if the hot spark appears. The initial adjustment of the field strength with the brushes at the practical maximum point and the current at the desired strength having been made the resistance in circuit is gradually cut out or shunted and the brushes rotated toward the minimum point of commutation gradually. As the brushes are rotated forward to vary the electro motive force of the dynamo the short circuited portion of the armature will cut lines of force directed from a different portion of the pole piece. If the lines of force as the brushes are adjusted forward vary in strength and number from those at the point of practical maximum commutation spark will be caused at the brushes of the one character or the other; a flashing spark if the lines of force are stronger; a burning spark if the lines of force are weaker. This spark in the initial observation of the action of the dynamo may be avoided by setting the brushes by hand to bring them at the non-sparking point; when this, however, is reached it will be observed that the current is varied in strength from that secured when the brushes were at the practical maximum point and as the resistance is cut out step by step and the brushes adjusted forward step by step, always keeping the brushes at the non-sparking point until all of the resistance has been cut out of circuit, the current will have varied step by step and that variation represents exactly the lack of uniformity of the lines of force. If the lines of force are too strong at the maximum point of commutation and gradually grow weaker toward the point of minimum commutation the current will gradually be weakened as the brushes are adjusted forward and vice versa. With the variation thus determined in the lines of force it is easy to make those lines of force uniform by boring the pole pieces eccentrically or perforating them centrally as above set forth.

In the drawings which are illustrative of our invention—Figure 1 is a front elevation of a dynamo electric machine embodying our invention. Fig. 2 is an elevation of the frame of a dynamo machine provided with consequent pole pieces perforated across their centers. Fig. 3 is a plan view of the same. Fig. 4 is a modification showing the pole pieces bored out eccentrically so as to be farther from the armature along their centers than at other portions of their faces. Fig. 5 is a modification showing the pole pieces divided magnetically at their centers, the space between the different parts of the pole pieces being filled by non-magnetic material.

Like parts are indicated by similar letters of reference throughout the different figures.

The preferable manner of cutting away the pole pieces is illustrated in Figs. 1, 2 and 3 in which perforations *a a b b* are shown through the centers of the pole pieces.

In Fig. 4 the pole pieces *c d* instead of being perforated are bored out eccentrically, the greatest eccentricity being at the centers of the pole pieces.

In Fig. 5 the consequent pole pieces are of

the usual form except that through their centers are inserted strips *e f* of non-magnetic material preferably brass. It will be understood that the particular shape of the perforations *a b* is not essential provided they are sufficient in number and size to cause the lines of force to be evenly distributed as hereinbefore set forth. The eccentrically bored pole pieces we have found of advantage but not so effective as cutting away the pole pieces as illustrated in Figs. 1, 2 and 3. The interposition of the non-magnetic strips *e f* has the desired electrical effect but for mechanical reasons we prefer to perforate the pole pieces since the size of the holes and their number may be more readily varied to adjust each machine in accordance with its requirements.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The method of creating a uniform field for the short circuited portion of the armature coils of a dynamo which consists in shifting the brushes from the maximum to the minimum, varying the resistance in circuit as the said brushes are shifted and maintaining during such shifting freedom from spark at the commutator by shifting the brushes slightly from the position that they would occupy if the field were uniform in order to determine the amount and character of the variation in the distribution of the magnetic lines of force and then perforating the pole pieces to the degree thus found to be necessary, substantially as described.

2. A dynamo electric machine having consequent pole pieces cut away or perforated on a line coincident with a plane passing through the axis of the armature shaft, such perforations being symmetrical with regard to said plane, whereby a uniform magnetic field is produced, regardless of the direction of the rotation of the armature, substantially as described.

In witness whereof we hereunto subscribe our names this 1st day of February, A. D. 1890.

CHARLES E. SCRIBNER.
ERNEST P. WARNER.

Witnesses:
ELLA EDLER,
C. G. HAWLEY.