(No Model.) 3 Sheets—Sheet 1.

E. P. WARNER.

ARMATURE FOR DYNAMO ELECTRIC MACHINES.

No. 346,965. Patented Aug. 10, 1886.

Fig. 1

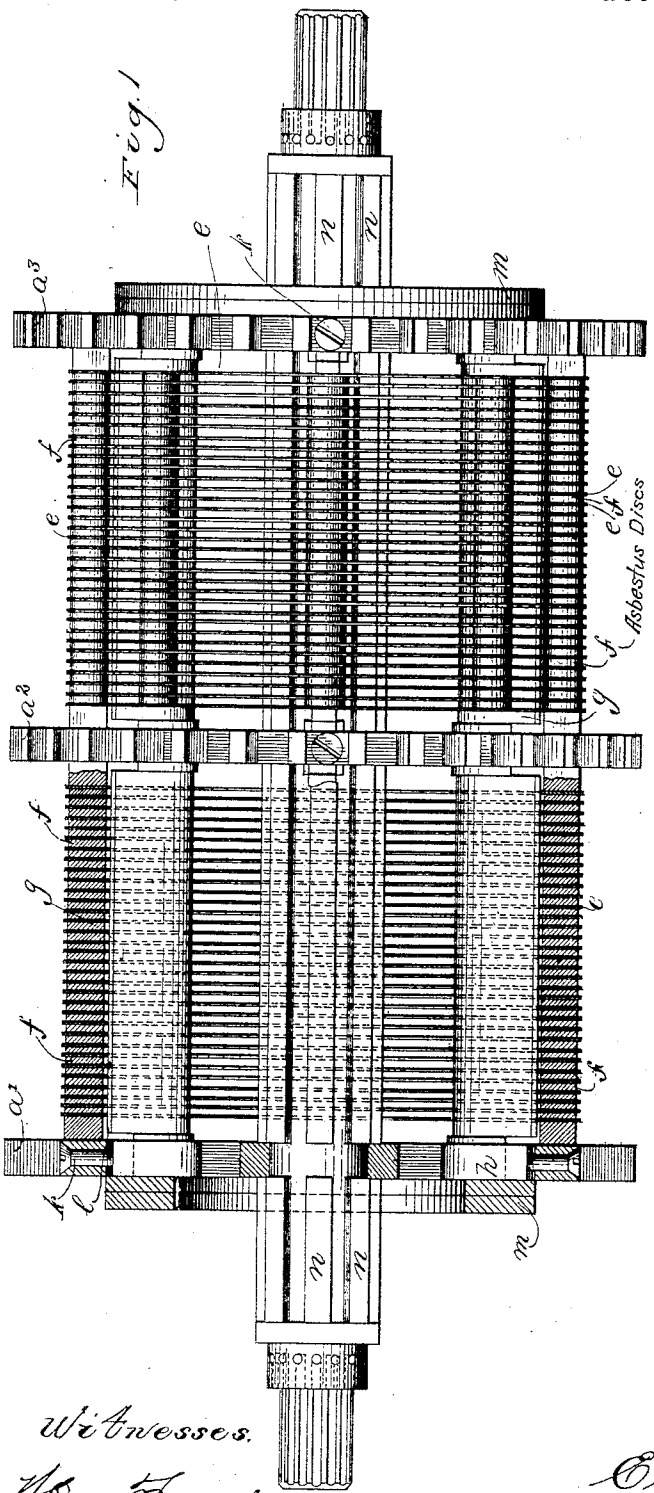
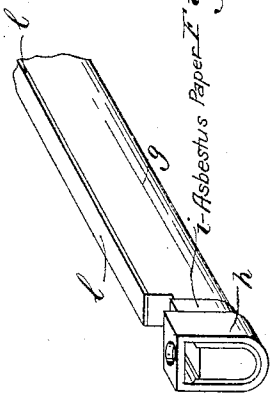


Fig. 3.



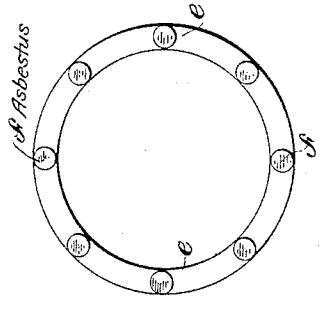


Fig. 2.

Witnesses.
Henry Brinkhuiter.
Sam'l B. Dover.

Inventor.
Ernest P. Warner.
per. George P. Barton
Attorney.

N. PETERS. Photo-Lithographer. Washington, D. C.

(No Model.) 3 Sheets—Sheet 2.

E. P. WARNER.

ARMATURE FOR DYNAMO ELECTRIC MACHINES.

No. 346,965. Patented Aug. 10, 1886.

Fig. 4.

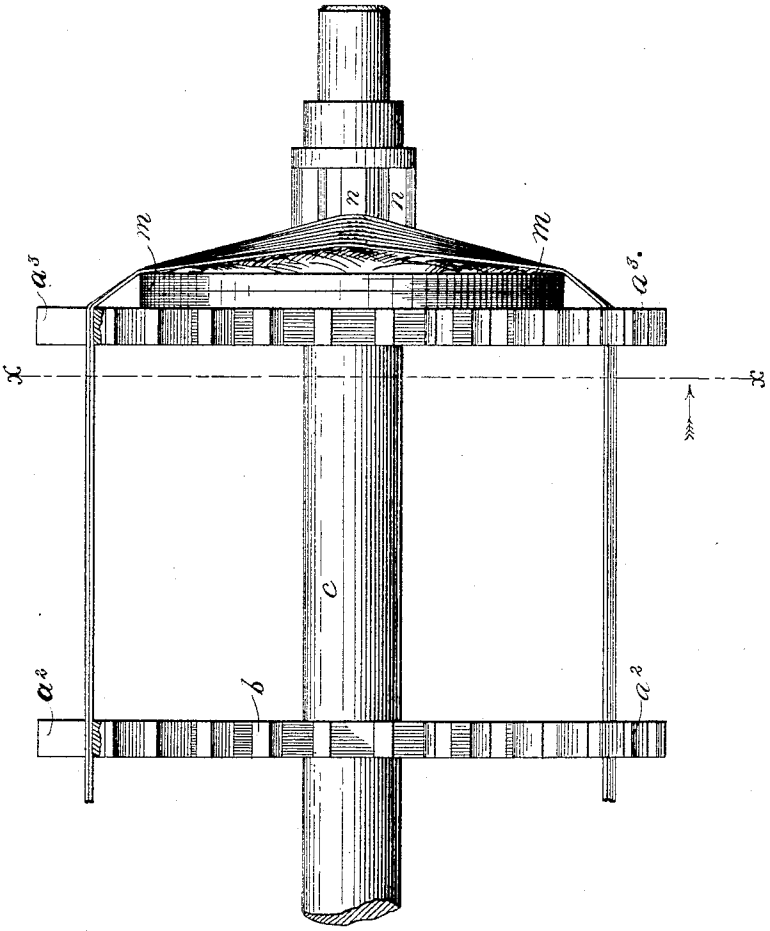
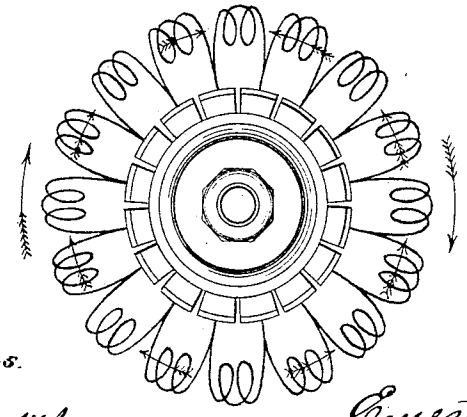


Fig. 5.



Witnesses.

H. Cusey Faulkner.

Sam'l B. Dover

Inventor.

Ernest P. Warner.

per. George P. Barton

Attorney.

N. PETERS. Photo-Lithographer. Washington, D. C.

(No Model.) 3 Sheets—Sheet 3.

E. P. WARNER.

ARMATURE FOR DYNAMO ELECTRIC MACHINES.

No. 346,965. Patented Aug. 10, 1886.

Fig. 6.

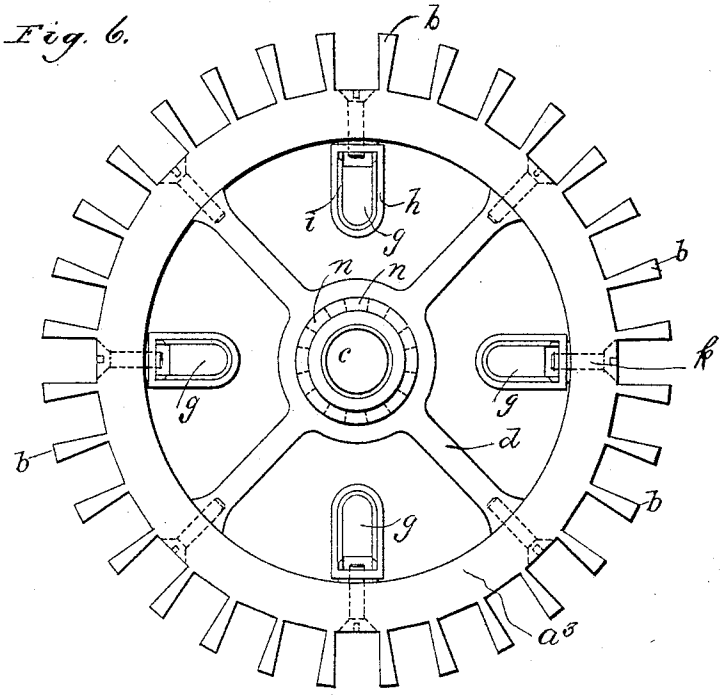
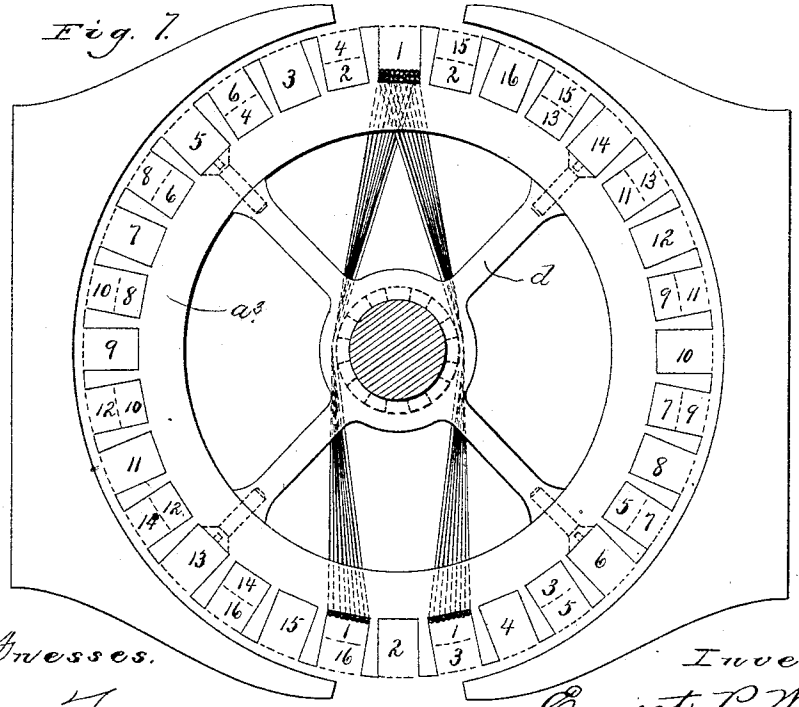


Fig. 7.



Witnesses.

Henry Faulconer.

Sam'l B. Dover.

Inventor.

Ernest P. Warner.

per. George P. Barton

Attorney.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

ERNEST P. WARNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

ARMATURE FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 346,965, dated August 10, 1886.

Application filed August 29, 1884. Serial No. 141,744. (No model.)

To all whom it may concern:

Be it known that I, ERNEST P. WARNER, a citizen 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 Armatures 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.

The objects of my invention are to prevent heating, to prevent sparking at the commutator, to secure perfect insulation between the coils, and in general to produce the greatest amount of current from a given power.

My invention consists in the construction of the various parts of the drum of the armature, and in winding the coils thereon, as herein described and claimed.

My invention is illustrated in the accompanying drawings, in which Figure 1 is a side view, partially in section, of the armature without the coils. Fig. 2 is a detailed view of one of the soft sheet-iron rings or annuli which form the core or inner magnetic field of the armature. Fig. 3 is a detailed view of a portion of one of the bars, which are placed parallel with the shaft of the armature, and serve to support the annuli. Fig. 4 is a detailed view showing one of the outer brass rings and the central brass ring of the armature, said rings being provided with lugs, which support and carry the coils of the wire wound upon the armature. Fig. 5 is an end view of a commutator, showing the manner in which the coils are connected to the commutator. Fig. 6 is an end view of the armature with the insulating-rings removed, so as to show the construction of the brass ring and the brass spider by which the brass ring is supported from the shaft. The insulated slings for supporting the bars are also shown. Fig. 7 is a view of the armature seen from section line $x\ x$ of Fig. 4, with the field-magnets.

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

The rings or carriers $a'\ a^2\ a^3$ are preferably of brass or other non-magnetic metal, and are provided with lugs b. These brass rings are each supported from the shaft c by a brass spider. Thus ring a^3 is supported by spider d, as shown in Figs. 6 and 7. The annuli e, which form the magnetic field or core of the armature, are of thin, soft sheet-iron, as shown more clearly in Fig. 2. These annuli are separated from each other, preferably, by insulating spacing-disks of asbestus, $f\ f$, as shown in Figs. 1 and 2. Asbestus is somewhat porous and also highly refractory. I therefore prefer asbestus to any other insulating material. It is evident, however, that other non-conducting materials may be used with satisfactory results. The bars g are supported by slings h, the asbestus paper i interposed serving to insulate the bars from the slings, as shown. These slings are preferably of brass, and are suspended from the outer rings, a' and a^2, by means of screws h. The bars g are insulated from the annuli by means of asbestus-paper strips l, as shown in Fig. 3. It will be seen that when the screws k are turned up the bars will be brought outwardly against the inner edges of the soft-iron annuli e, as shown in Fig. 1, and since the outer edges of the bars are made rounding, the asbestus covering will be held firmly between the edges of the bars and the inner edges of the annuli. Rings $m\ m$, of asbestus or other insulating material, are placed about the shaft outside the brass carriers $a'\ a^2$, and serve to insulate the coils of wire from the brass. Parallel strips $n\ n$, of asbestus or other insulating material, are placed about the outer ends of the shaft, as shown in Figs. 1, 4, 6, and 7, and serve to keep the wire away from the metal shaft.

I will now describe the manner in which I wind the coils about the armature. The frame or drum of the armature is placed horizontally, the journals resting upon supports or crotches, which allow it to be turned freely by the workman while winding on the insulated wire. The brass rings $a'\ a^2\ a^3$ are so placed that the coil-spaces between the lugs will be in line, as shown in Figs. 1 and 4. I have shown thirty-two of these spaces, thus giving room for sixteen coils of wire passing entirely about the drum from end to end. I wind each of the coils so that all the convolutions will be included within one space on one side of the armature, while on the opposite side of the

armature the convolutions will be distributed between two or more spaces, preferably two.

Heretofore it has been common to wind the different coils so that all the convolutions of each will come in spaces diametrically opposite. By my method of winding the space directly opposite the one which includes the whole of any given coil does not include any of the convolutions of said given coil, but the convolutions are divided half and half between the spaces on each side of the space which is diametrically opposite the space containing all the convolutions.

As shown in Fig. 7, the spaces marked 1, 2, &c., to 16 indicate the order in which the coils are wound upon the drum and the positions which they occupy, respectively. The spaces marked 1, 2, &c., to 16 will be each filled by the convolutions of a single coil, while the other spaces, marked $\frac{1}{3}$, $\frac{3}{5}$, &c., to $\frac{1}{16}$, will each be filled by one-half of the convolutions of the two coils indicated by the two digits of said spaces, respectively. The coils are wound in layers. Each layer may consist of eight convolutions, as shown, and each coil may consist of eight layers or sixty-four convolutions. The coils are thus wound in the same direction and connected together, the inner end of one coil being joined to the outer end of the next coil, and from the joint a connection leads to a segment of the commutator. This is illustrated in Fig. 5, the arrows indicating the direction of the current in the different coils. By thus distributing the convolutions of the coils on one side of the armature, sparking at the commutator is prevented or reduced and the efficient strength of the current increased.

One of the reasons why sparking at the commutator is prevented by my invention is the fact that the divided portions of any given coil are so disposed with respect to the magnetic field that they tend to generate currents in opposite directions, respectively, at the moment the opposite or undivided portion of the coil passes the neutral point, the coil being thus rendered neutral.

I claim—

1. The combination, in the armature of a dynamo-electric machine, of the bars *g*, the thin soft-iron rings, and the strips of insulating material, *l*, interposed between said rings and the different bars or supports *g*, whereby the rings and bars are insulated, substantially as and for the purpose specified.

2. The combination, in the armature of a dynamo-electric machine, of the brass rings $a' a^2 a^3$, provided with lugs *b b*, the shaft of the armature, and spiders for supporting the brass rings, substantially as and for the purpose specified.

3. The combination, with the brass rings or carriers provided with spaces for the coils, of yokes *h*, insulated from bars *g*, the bars *g*, held against the annuli and insulated therefrom, and the coils of the armature, as and for the purpose specified.

4. The combination, with the drum of a dynamo-electric machine, of coils wound in the spaces provided thereon, as described, all the convolutions of each coil being included within its space on one side of the drum and distributed or divided between two or more spaces on the opposite side, substantially as specified.

5. The combination, upon the shaft of a dynamo-electric machine, of asbestus rings or circular pieces *m m* and asbestus strips *n n*, substantially as shown and described.

6. The combination, with the coils of a dynamo-electric machine, of the shaft, the insulating-rings *m m*, and the strips *n n*, placed upon the shaft, whereby the coils are insulated from the shaft, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 22d day of August, A. D. 1884.

ERNEST P. WARNER.

Witnesses:
GEORGE P. BARTON,
H. ODELL.