C. F. BRUSH.

Dynamo-Electric Machine.

No. 217,677. Patented July 22, 1879.

Fig. 1.

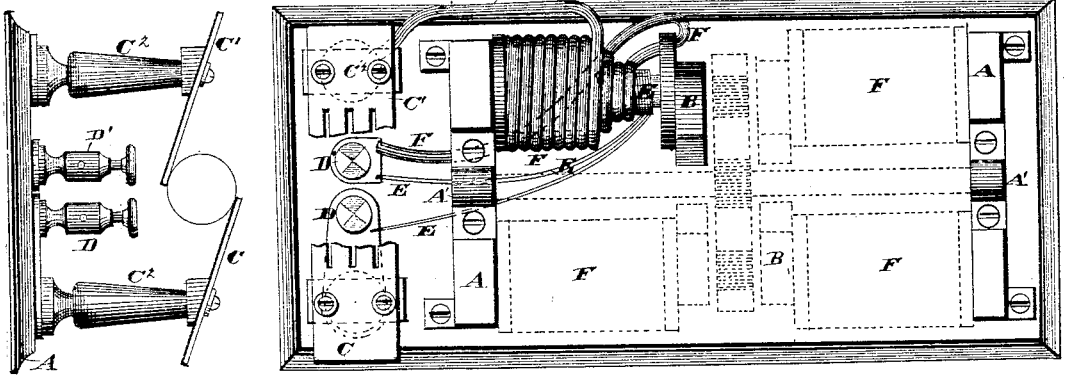


Fig. 3.

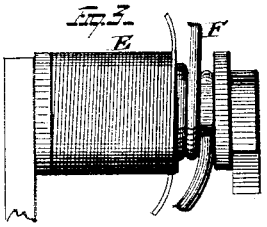


Fig. 4.

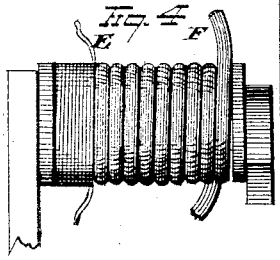


Fig. 2.

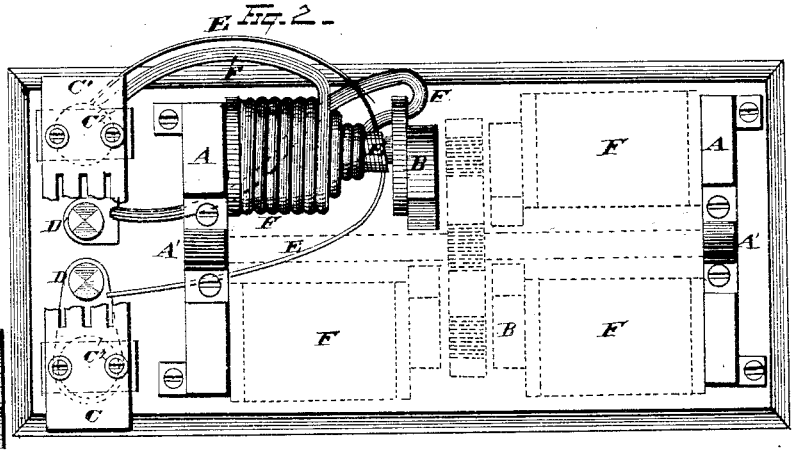
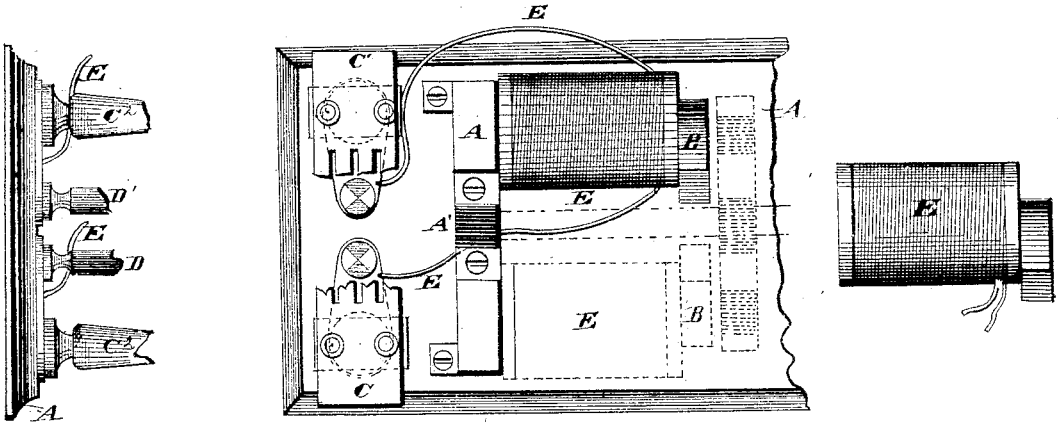


Fig. 5.



WITNESSES

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2 Sheets—Sheet 2.

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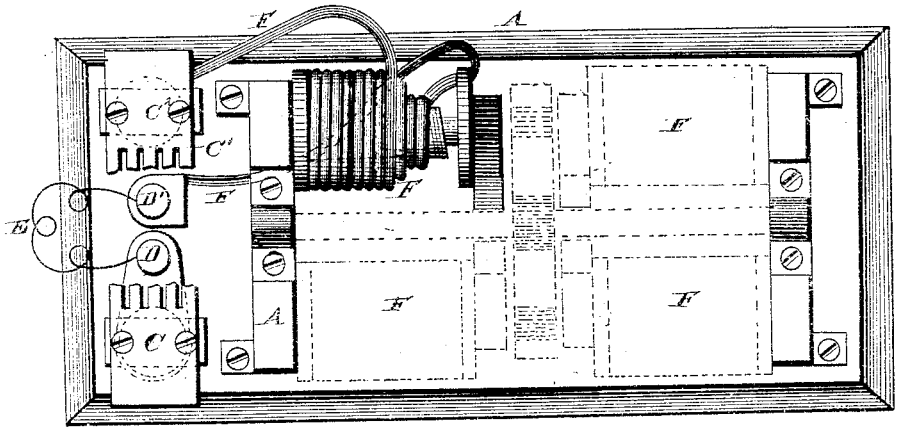
Fig. 5



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UNITED STATES PATENT OFFICE.

CHARLES F. BRUSH, OF CLEVELAND, OHIO.

IMPROVEMENT IN DYNAMO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **217,677**, dated July 22, 1879; application filed March 11, 1878.

To all whom it may concern:

Be it known that I, CHARLES F. BRUSH, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Dynamo-Electric Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to dynamo-electric machines; and has for its object the maintenance in such machines of a "magnetic field" while the machine is running, whether the external circuit is closed or open.

In dynamo-electric machines as ordinarily constructed, no magnetic field is maintained when the external circuit is open, except that due to residual magnetism; hence the electromotive force developed by the machine in this condition is very feeble.

It is only when the external circuit is closed through a resistance not too large that powerful currents are developed, owing to the strong magnetic field produced by the circulation of the currents themselves around the field-magnets.

Such machines are not well adapted to certain kinds of work, notably that of electroplating. For this purpose a machine arranged to do a large quantity of work at one operation may fail entirely to do a small quantity, because of the comparatively high external resistance involved in the latter case and the low electro-motive force of the machine at the start. Again, it is well known that during the process of electroplating, a very considerable electro-motive force is developed in the plating-bath in a direction opposed to the current from the dynamo-electric machine. If, now, the current from the machine is momentarily weakened, by accident or otherwise, its magnetic field, and consequently its electromotive force, are correspondingly reduced. If the latter falls below the opposing electromotive force of the bath, it will be overcome by it, and the machine will have the direction of its current reversed. This accident often happens with plating-machines, and is a source of much annoyance.

It will now be obvious that if even a moderately-strong magnetic field be constantly maintained within the machine, both of the above-described difficulties will be eliminated. Other useful applications of a "permanent-field" machine will readily suggest themselves.

I attain my object by diverting from external work a portion of the current of the machine, and using it, either alone or in connection with the rest of the current, for working the field-magnets. I prefer the latter plan of the two just above mentioned, especially for electroplating-machines.

If, now, the external circuit be broken entirely, the magnetic field will, in the former plan just mentioned remain unimpaired, and in the latter plan will remain sufficiently strong to effect the desired end.

In applying my invention to dynamo-electric machines, I wind the cores of the field-magnets with a suitable quantity of comparatively fine wire having a high resistance in comparison with that of the external circuit and the rest of the wire on the machine. The ends of this wire are so connected with other parts of the machine that when the latter is running a current of electricity constantly circulates in said wire, whether the external circuit be closed or not. The high resistance of this wire prevents the passage through it of more than a small proportion of the whole current capable of being evolved by the machine; therefore the available external current is not materially lessened.

When this device, which I have called a "teaser," is used in connection with field-magnets, also wound with coarse wire, as shown in Figure 1 of the drawings, for the purpose of still further increasing the magnetic field by employing the main current for this purpose, in the usual manner, then the "teaser" may be so arranged that the current which passes through it will also circulate in the coarse wire, thus increasing the efficiency of the device. This arrangement, illustrating one of the most common applications of my invention, is shown in Fig. 1 of the drawings.

Instead of the teaser and helix F being con-

structed from wire of different gages, the size of wire may be alike in both, or the teaser-wire may be coarser than the principal magnet-wire; but in these cases the waste of current through the teaser would be excessive, leaving comparatively little for use in the external circuit.

Instead of the magnet being surrounded with both teaser and ordinary helix F, the latter may be omitted, and the teaser increased in gage and length (thus still maintaining its high resistance) until it will of itself maintain sufficient magnetic field. This modified form of machine is shown in Fig. 5 of the drawings.

I will now proceed to describe the construction of one or more forms of device embodying my invention.

In the drawings, Fig. 1 represents in plan view a portion of a dynamo-electric machine, showing one of its magnetic helices partially wound and so arranged as to exhibit the teaser and helix F, also to show one form of arranging the currents of the teaser and main wire. Fig. 2 is the same, showing, however, a modified arrangement of the currents of teaser and main wire. Fig. 3 shows a modified method of applying the teaser by wrapping it upon the outside of the main helix instead of within it, as shown in Fig. 1. Fig. 4 shows another modified form of teaser, where it may be wrapped around the magnet alongside and independent of the main helix. Fig. 5 shows another modified form of my device, in which the main helix F is omitted, and the magnet clothed only with the teaser. Fig. 6 shows still another modification of my invention, wherein the teaser does not surround the magnet-cores at all.

A A represent the base and standards of a dynamo-electric machine. A′ A′ are the bearings in which revolves the shaft that carries the armature and commutator-cylinder.

B is one arm of a field-magnet, of which said magnets there are two in such a machine as here shown—one upon either side of the revolving armature.

C C^1 are metallic brushes for collecting the current from the commutator-cylinder, and conducting the same down through their supports C^2 to suitable connections, where it is disposed of according to the arrangement of the circuits.

D D′ are binding-posts, representing the positive and negative poles of the machine, from which proceed the wires or other conductors for conveying said current to the place of its application.

E represents the teaser, already sufficiently described, so far as the principles of its application and operation are concerned.

It therefore only remains to explain a few of various modifications in the manner of applying said teaser and the arrangement of the currents.

As shown in Fig. 1 of the drawings, the teaser E is first wrapped, say, in two courses around the core of the magnet B, and the main helix-wire F is wound outside and independent of the teaser. One end of the teaser-wire is connected with the binding-post D and brush C, and the other with the post D′. The main helix-wire F passes from the post D′, to which it is connected, to the magnet-core, around which it forms a helix, and, finally, connects with the brush C^1.

Thus arranged, the current will be as follows while the external circuit is closed: Tracing it from brush C, it divides itself between the external circuit and the teaser inversely as their respective resistances, and again uniting into an undivided current at the post D′, it passes on through the helix F to the brush C^1.

If, now, the external circuit be opened, the reduced current consequently evolved by the machine will take the following course, by which it will be clearly perceived how in such case a permanent magnetic field is maintained. (The same conditions would obtain if the machine were to be originally started on an open external circuit.) Tracing, now, the current from the brush C, it passes through the teaser E, around its helical portion, down to binding-post D′, where it meets the wire F of the main helix, through which it passes again around the magnet, and finally to the brush C^1.

This arrangement of circuits, as shown in Fig. 1, while for many purposes preferable, on account of the increased amount of current convolutions passed around the magnets, is not the only one that will prove effective in carrying out and embodying my said invention. Such an arrangement of currents as shown in Fig. 2 will serve an operative purpose. In this form the teaser E, instead of connecting with the wire F at the binding-post D′, as hereinbefore specified, takes the following course: Commencing, say, at its connection with the brush C and post D, it proceeds to describe a helix around the magnet, and then terminates in its connection with the brush C^1.

It is not at all essential that the teaser be wrapped around the magnet underneath the wire F. A variety of methods would be equally as operative as the above, among which may be mentioned that illustrated in Fig. 3 of the drawings, where the teaser is wrapped outside of the helix F; also, that shown in Fig. 4, where the teaser is wrapped alongside the helix F, forming a separate and independent section or helix.

Fig. 5 of the drawings is designed to show the arrangement of the current when the wire F is omitted, as hereinbefore described, in which case the magnets are wound only with the teaser.

Fig. 6 of the drawings is designed to show the arrangement of parts and direction of current when the teaser-wire E does not surround a magnet-core, but merely serves to join, through a high resistance, the positive and negative poles D D′ of the machine. In this case the teaser-wire need not necessarily form

a helix, but may be disposed of in any convenient manner, either within the machine or exterior to it.

The direction of the current through the several parts of the apparatus is the same as described in connection with Fig. 1 of the drawings, and the effect produced is the same, but less in degree, since the magnetizing power of the helix F only is brought into action, instead of that of both helices, F and E, as in the former case.

It should be distinctly understood that I do not limit my invention to the form adaptable to any particular dynamo-electric machine, inasmuch as it is susceptible of a variety of modifications, whereby it may be applied to devices of various constructions without any material departure from its spirit and intent, or the essential principles of its construction and operation. The forms in which I have here chosen to demonstrate it are those best applicable to such a dynamo-electric machine as shown in United States Patent No. 189,997, granted to me April 24, 1877.

What I claim is—

1. In a dynamo-electric machine, the wire or helix E, having a comparatively high resistance and kept constantly in closed circuit while the machine is running, in combination with the magnet-wire or helix F, as commonly employed.

2. In a dynamo-electric machine in which the coils around the field-of-force electro-magnets are included in the main or operative circuits, the combination of such main circuit with a constantly-closed differential circuit of prescribed resistance, for the purpose of maintaining the flow of the current through the coils surrounding the electro-magnets in the machine when the main or operative (external) circuit is broken, substantially as shown.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES F. BRUSH.

Witnesses:

LEVERETT L. LEGGETT,

JNO. CROWELL, Jr.