(No Model.)

2 Sheets—Sheet 1.

S. E. NUTTING.

DYNAMO ELECTRIC MACHINE.

No. 448,666. Patented Mar. 24, 1891.

Fig. 1.

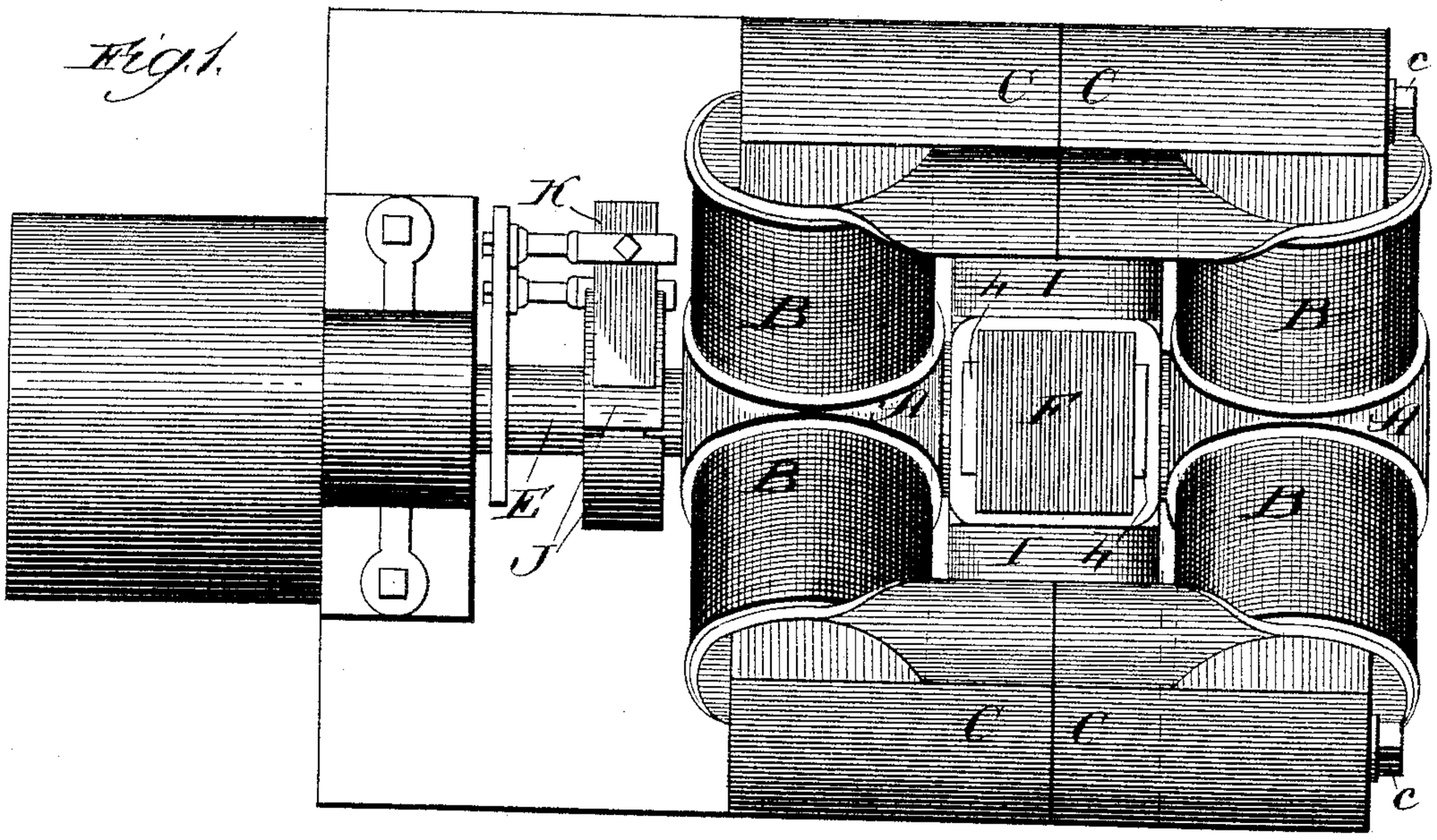


Fig. 2.

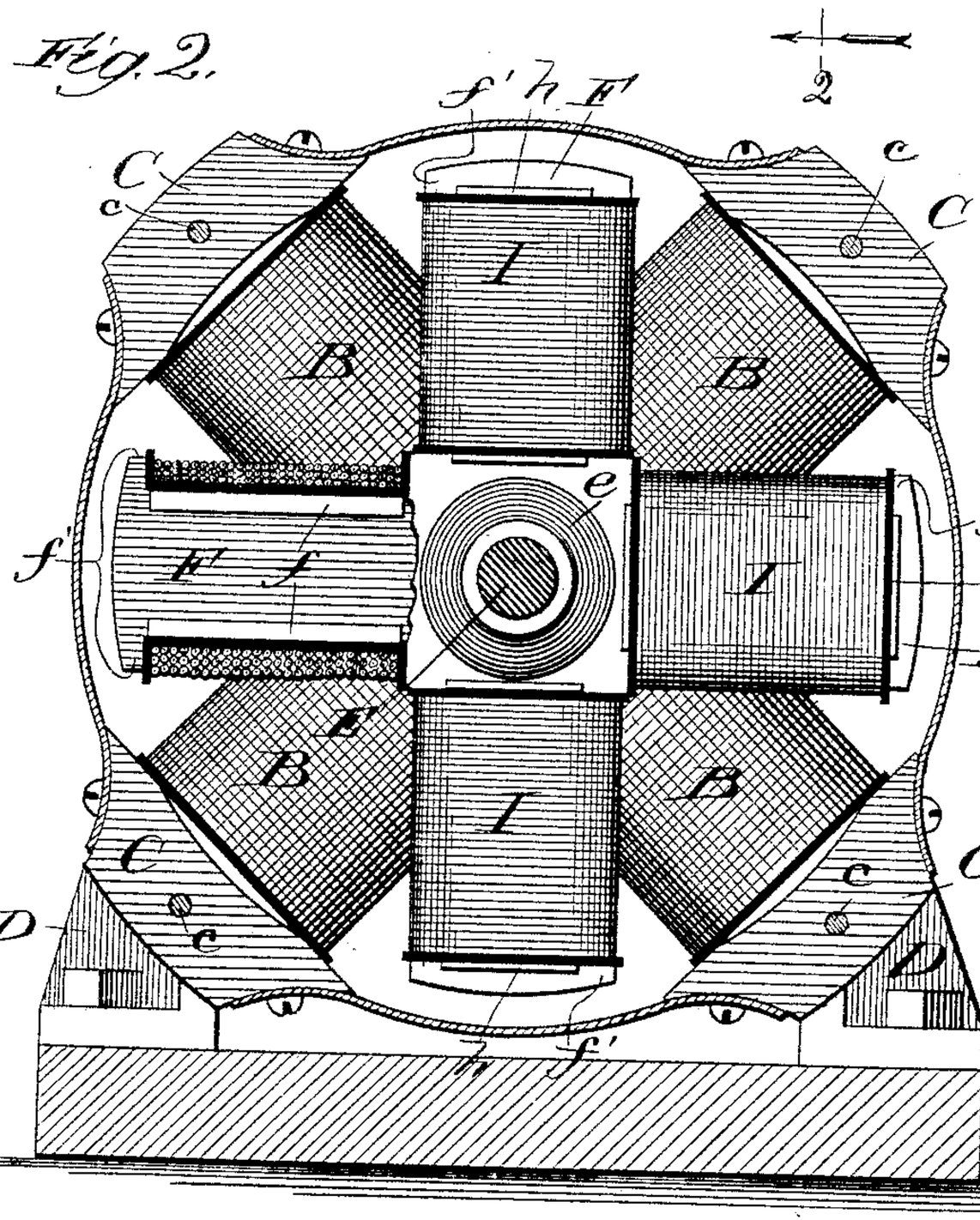
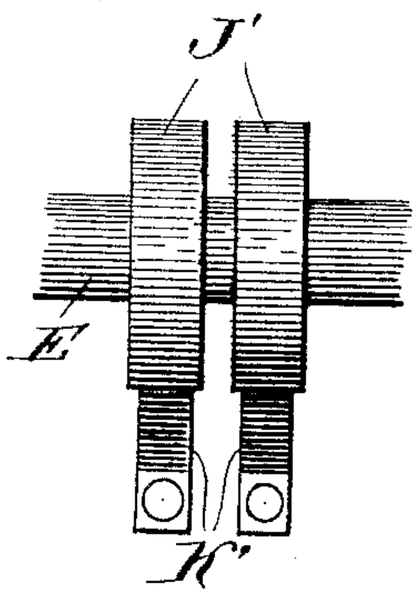


Fig. 3.



Witnesses:
Chas. E. Gaylord,
Clifford P. White

Inventor:
Samuel E. Nutting,
By Banning & Banning & Payson,
Attys.

(No Model.) 2 Sheets—Sheet 2.

S. E. NUTTING.

DYNAMO ELECTRIC MACHINE.

No. 448,666. Patented Mar. 24, 1891.

Fig. 4.

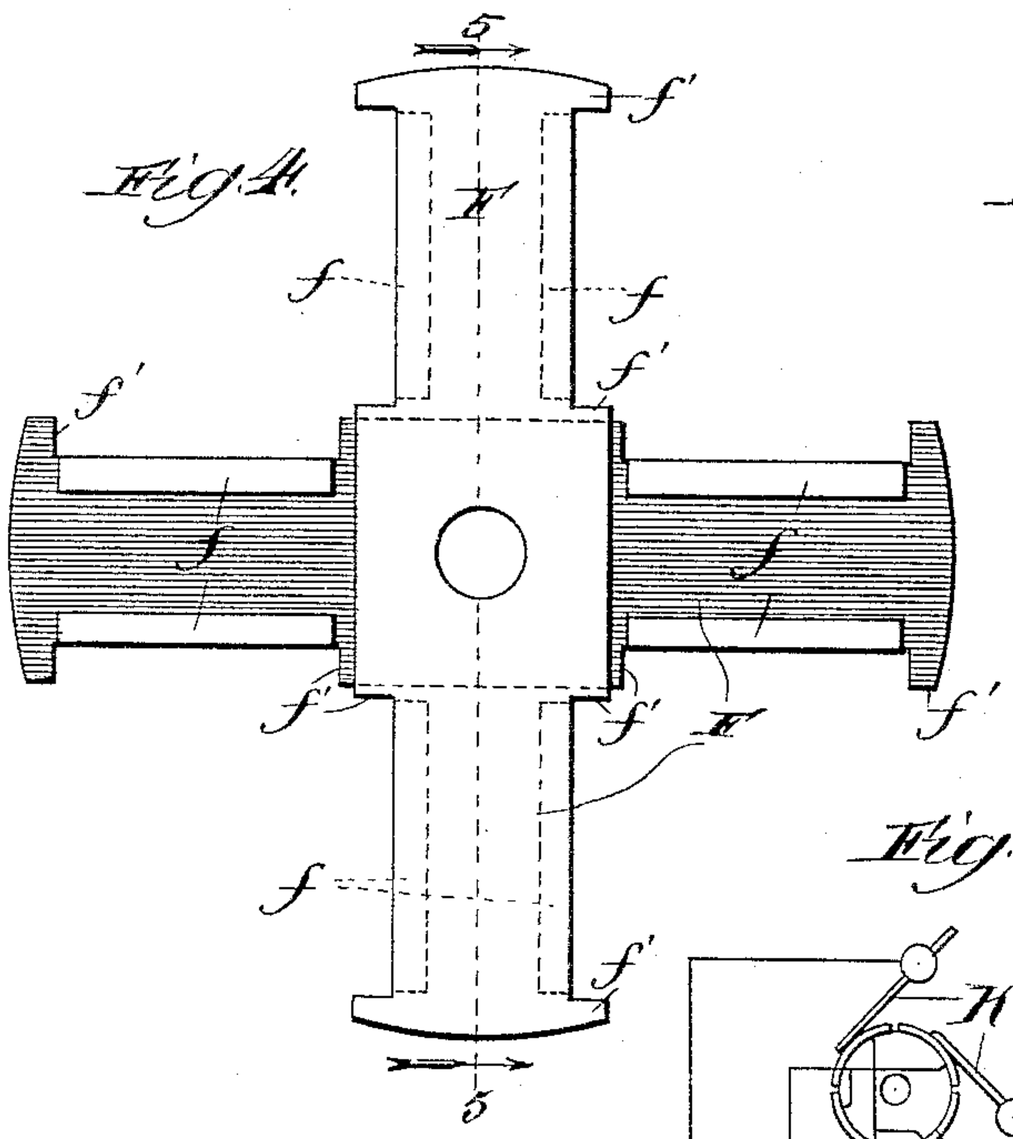


Fig. 5.

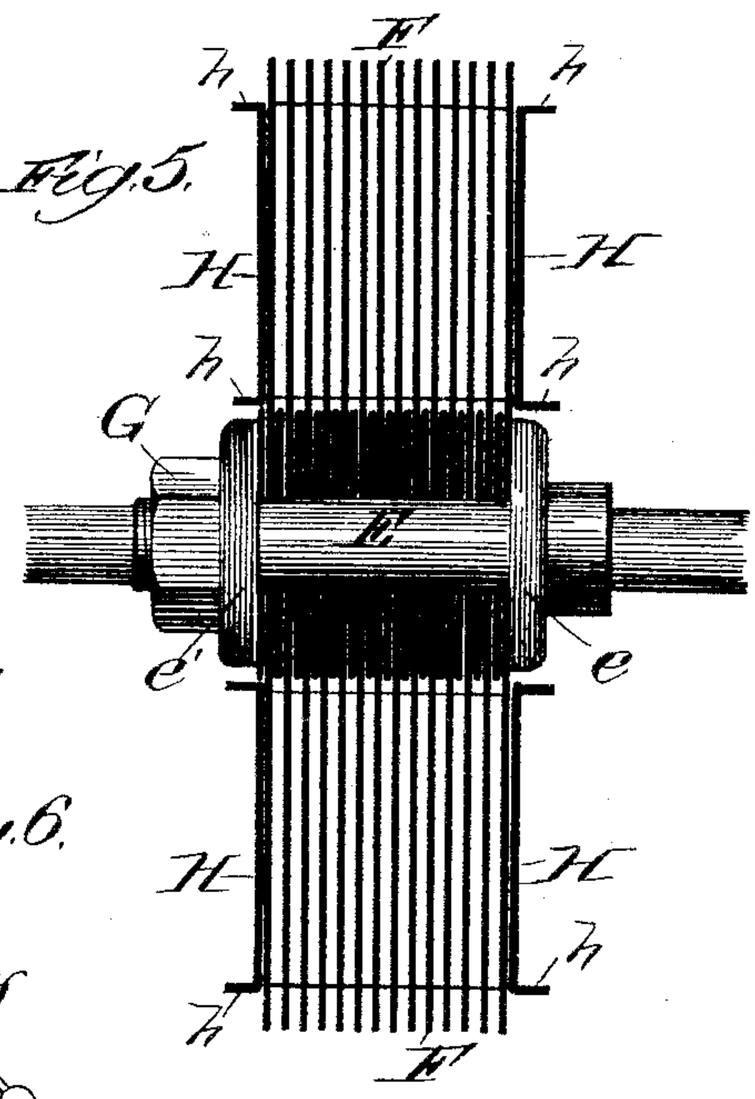


Fig. 6.

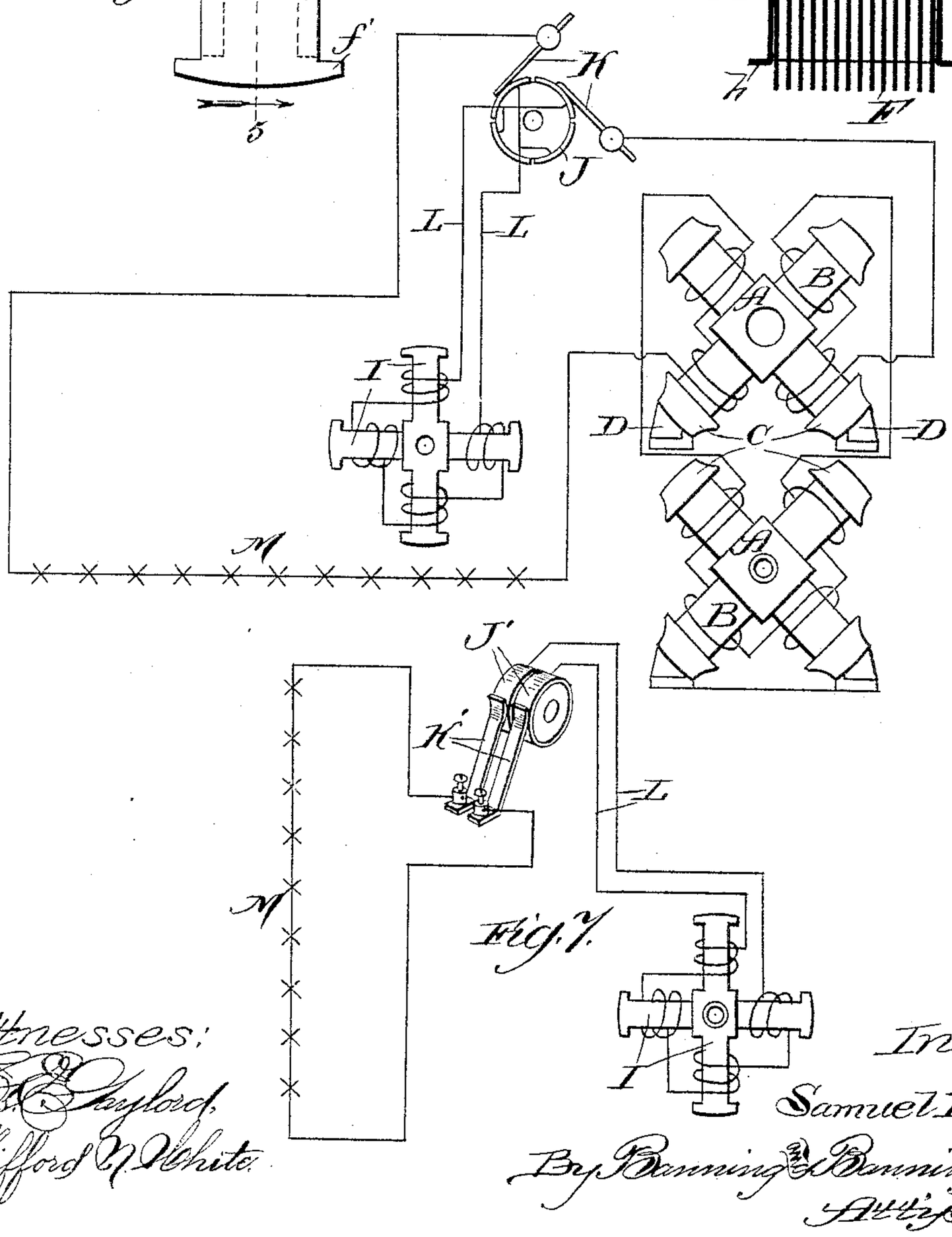


Fig. 7.

Witnesses:
Chas. E. Gaylord.
Clifford D. White.

Inventor,
Samuel E. Nutting,
By Banning & Banning & Payson,
Attys.

UNITED STATES PATENT OFFICE.

SAMUEL E. NUTTING, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE NUTTING ELECTRIC MANUFACTURING COMPANY, OF SAME PLACE.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 448,666, dated March 24, 1891.

Application filed May 13, 1890. Serial No. 351,668. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL E. NUTTING, a citizen of the United States, residing at Chicago, Illinois, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

The object of my invention is to make a generator of electricity which will be capable of being changed to produce at will either a direct or alternating current and of simplifying the construction and operation of such machines without diminishing their efficiency and generating-power; and my invention consists in the methods and details of construction hereinafter described and claimed.

In the drawings, Figure 1 is a plan view of my dynamo-electric machine or generator. Fig. 2 is an end view of a section taken in the line 2 of Fig. 1, looking in the direction of the arrow. Fig. 3 is a plan view of a commutator used in connection with the machine. Figs. 4 and 5 are details of the armature-cores. Fig. 6 is a diagrammatic view of the circuit, showing its connections when used to produce a direct current; and Fig. 7 is a diagrammatic view of the circuit when used for producing an alternating current.

In making my improved dynamo-electric machine or generator I make two field-irons A, or "spiders," as they may be termed, preferably of cast metal capable of being magnetized. These spiders are provided with four legs or extensions at right angles to each other, forming the cores of the field-coils B, with a central hub uniting them together in one piece. This affords a solid magnetic field-piece formed of one iron, on which all of the four coils are wound with wire without either of the cores being in the way or interfering with the winding of the others by machinery while the field-iron is in the winding-lathe. The legs of the spiders are provided with flanges toward their outer ends to form spools between the flanges and the hub in which the wire of the field-coils is intended to be built up and arranged. At the outer ends of the legs are provided inwardly-projecting polar extensions C, which abut against each other to form a connection between the two spiders and practically unite them into one piece. To hold them together, I arrange bolts *c*, preferably threaded at their ends, running through one of the polar extensions and screwing into a hole in the other of the proper size to receive them. In this way the spiders are securely fastened together. To enable the spiders to be properly supported in an upright position, feet D may be cast on the bottom set of legs, by which they may be fastened to the block or base on which they are intended to rest in operation. The spool portions of the legs of the spider are filled with wire coiled in proper condition to constitute the field-coils before the two sets of spiders are fastened together, as above explained. The polar extensions of the spiders are intended to be of sufficient length to leave a space between the two sets of field-coils arranged on their respective spiders for the location and operation of the armature. The hubs of the two spiders are provided with a hole, through which a shaft E, on which the armature is intended to be mounted, may be inserted and by which it may be rotated.

To build up the armature I arrange a collar or shoulder *e* at the proper position on the shaft, to be, when the parts are assembled, just inside of one of the spiders. I take a number of thin strips of metal F, preferably of the softest sheet-iron, provided with a hole in their center to enable them to slip over the shaft E. In building up the armature I take one of these strips and slip it over the shaft until it comes against the collar or shoulder *e*. I then take another strip and slip it over the shaft until it comes against the first one arranged in place, but at right angles to it. I then take a third strip and in like manner slip it over the shaft, but parallel to the first and at right angles to the second. In this manner I continue to build on piece after piece, alternating their position so that each shall be at right angles to the one immediately preceding it. After I have placed as many strips on the shaft as forms the core of the armature to the desired thickness I slip on another collar or shoulder *e'* and secure the same firmly against the strips, pressing them tightly together by the nut G. As the strips F are, as above explained, made of thin sheet metal, I prefer to cut into their edges

and fold down a portion *f*, as indicated by dotted lines in Fig. 4.

In building the strips onto the shaft, as above described, they lie one against another, filling the space between the collars *e* and *e'* with a compact and solid mass. By folding over the edges *f* of the strips the extending portions of the strips are also caused to lie firmly against each other. The portion folded over fills the edges of the spaces that otherwise would be caused by placing the strips at alternate directions to each other. At the same time a channel or passage for the circulation of air extending from the end of the strips to the point where the cross or alternating strips fill the space will be secured. As the coils of the armature are intended to be arranged a slight distance from the "solid central hub," as it may be termed, of the armature, these passages or channels will extend from the ends of the strips in beyond the inner edges of the coils, permitting a complete and free circulation of air through the core of the armature. By this arrangement the air-channels do not prevent or interfere with the use of the requisite quantity of iron to form efficient armature-cores. By bending down the strips *f*, as above explained, I also secure flanges *f'* on two sides of the strips, constituting or forming a spool in which the wire of the armature may be coiled. To form the spool on the other two sides of the strips I take pieces of sheet-iron H and bend up their edges to form flanges *h*, coinciding with the flanges *f'*, and lay them on the flat sides of the strips, which of course were unprovided with flanges, by folding in the edges *f*. I then coil the wire in this spool until I have built up the requisite thickness for the armature. As the cores of the armature are at right angles to each other, the wire may be coiled on them by machinery with the same facility as in the case of the field-cores. After the armature has thus been built up the parts are assembled by slipping the hubs of the two spiders over the shaft at each side of the armature until the polar extensions come together, when they are fastened by the bolts *c*, as above explained.

It will of course be understood that the armature is mounted on the shaft so as to be fixed thereto and rotated therewith. When the parts are assembled, therefore, the shaft may be rotated by any convenient motive power, and so cause the armature to rotate between the two sets of field-coils and of course within the field.

It will be apparent from the above explanation that the armature-coils, which we will designate by the letter I, will in their revolutions be parallel with the field-coils part of the time and part of the time out of parallelism. As the ends of the armature-coils pass under the polar extensions they will be parallel and close to the field-coils and in the position of the strongest magnetic induction. In winding the field-coils the wire is coiled in that direction which will give polarity of different kinds to the alternate legs of the spider. In other words, one leg of the spider will be positive and the next negative, and so alternating through all the legs. This will be understood by reference to Fig. 6, where the wire may be traced from one leg of the spider to another. In winding the two spiders intended to be assembled together it will be understood, of course, that the legs of the spiders are to be alike, so that when the polar extensions are brought together they will connect the legs having the same polarity, which are usually termed "consequent poles." As the armature rotates in the field the armature-coils are constantly passing from a position of parallelism to the positive coils to a position of parallelism to the negative coils, so as to constantly alternate from one to the other. As the armature revolves beneath the polar extensions it is of course magnetized, and as it passes under the next set of polar extensions its magnetism is reversed. In this way the current which is induced in the armature constantly alternates in its direction.

When I desire to rectify the current, so as to constantly deliver it in one direction only and cause it to charge the field of the machine, I connect the wire to a commutator J, formed of four sections or parts, as shown in Fig. 6, and place the brushes K so that they bear upon successive segments of the commutator in positions at right angles to each other. The brushes are thus placed because the two ends of the wire L from the armature connect with the commutator at opposite sections, the one wire with two opposite sections and the other wire with the two remaining opposite sections. This will be understood from an inspection of Fig. 6. The arrangement of the wires and brushes, however, need not be explained in detail, as I do not make them the subject of my claims. In Fig. 7 I show the arrangement of a commutator J' and brushes K' where it is intended to use the alternating current just as it is generated. By using the one arrangement or the other shown in Figs. 6 and 7 I am able to deliver either a rectified or an alternating current. In both figures I have represented electric lights by the letter M to indicate a use to which the current may be put.

What I regard as new, and desire to secure by Letters Patent, is—

1. The combination of a field-iron consisting of a hub and four cores for field-coils projecting radially at right angles to each other from the hub and in the same plane, polar extensions projecting from the outer ends of the cores at right angles with their plane, and an armature adapted to rotate within a circle partly inclosed by the polar extensions and in a plane parallel to the plane of the cores, substantially as described.

2. The combination of two sets of field-irons, each consisting of a hub and four cores for field-coils projecting radially at right an-

gles to each other from the hub and in the same plane, polar extensions projecting from the outer ends of the cores of one set at right angles with their plane and connecting with the outer ends of the cores of the other set, and an armature adapted to rotate within a circle partly inclosed by the polar extensions and in a plane parallel to the plane of the cores of the two sets and between them, substantially as described.

3. In an armature-core, the combination of an armature-shaft, a series of thin strips of magnetic material centrally mounted on the shaft, and a series of thin strips of magnetic material centrally mounted on the shaft at right angles to and alternating with the series of strips first above mentioned, substantially as described.

SAMUEL E. NUTTING.

Witnesses:
GEORGE S. PAYSON,
THOMAS A. BANNING.