(No Model.) 3 Sheets—Sheet 1.

J. HOPKINSON & A. MUIRHEAD.

DYNAMO ELECTRIC MACHINE.

No. 280,039. Patented June 26, 1883.

FIG. 1.

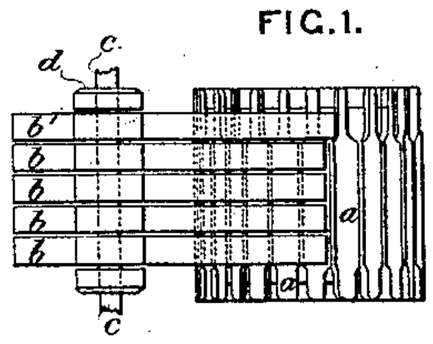


FIG. 11.

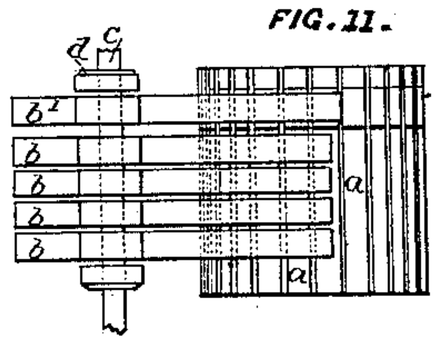


FIG. 2.

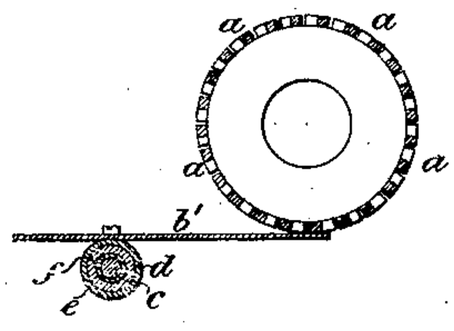


FIG. 3.

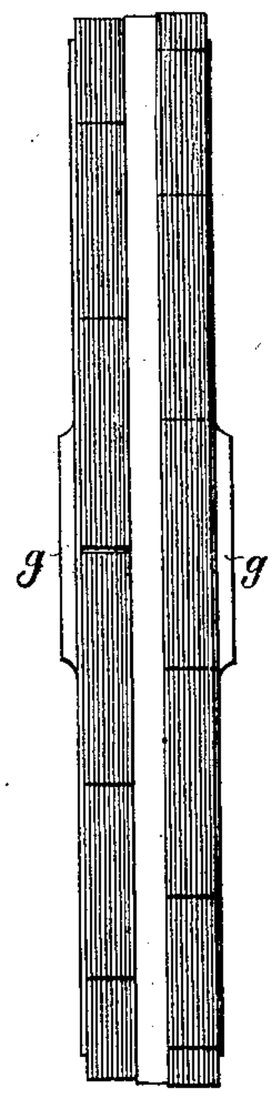


FIG. 4.

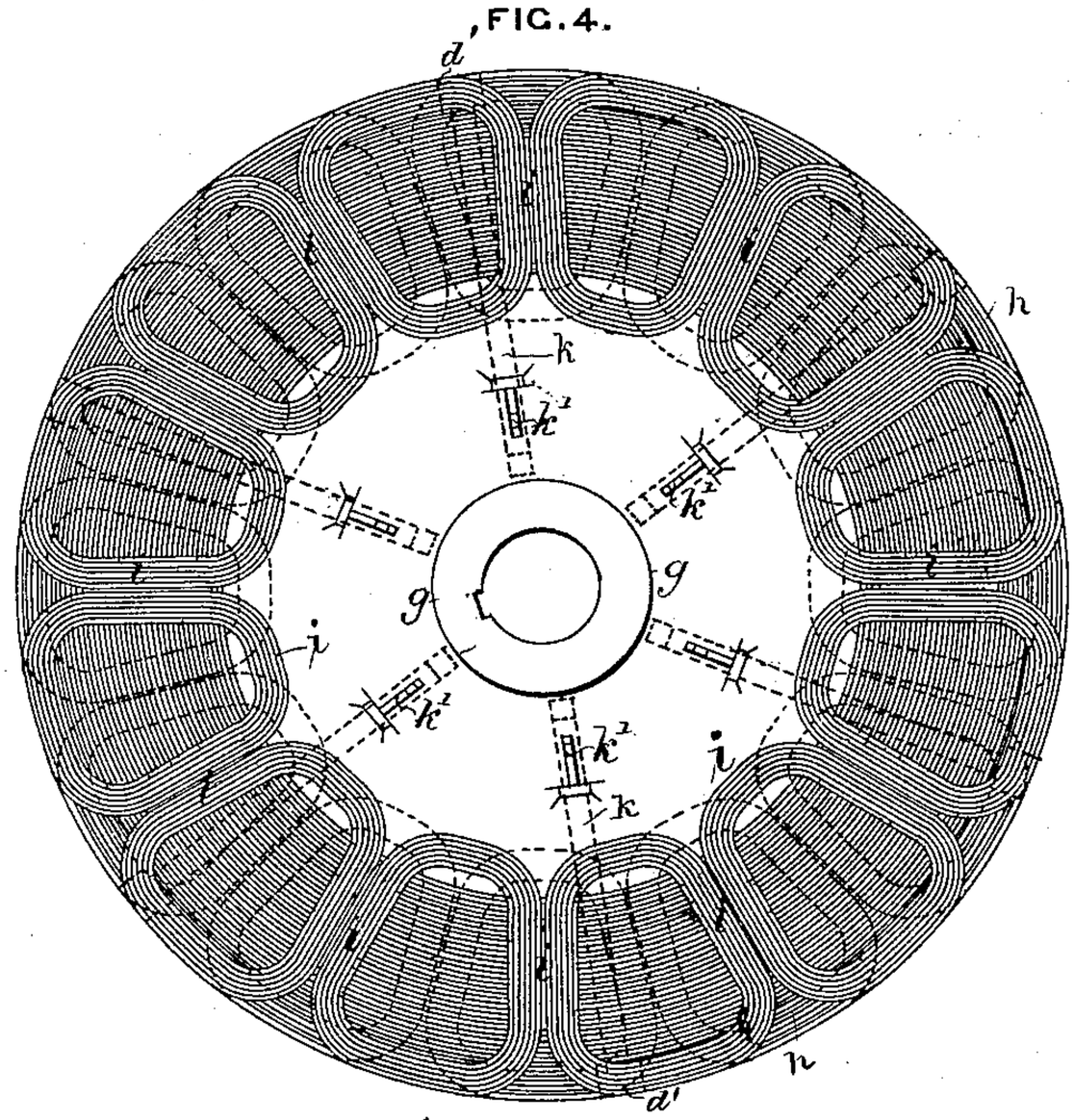
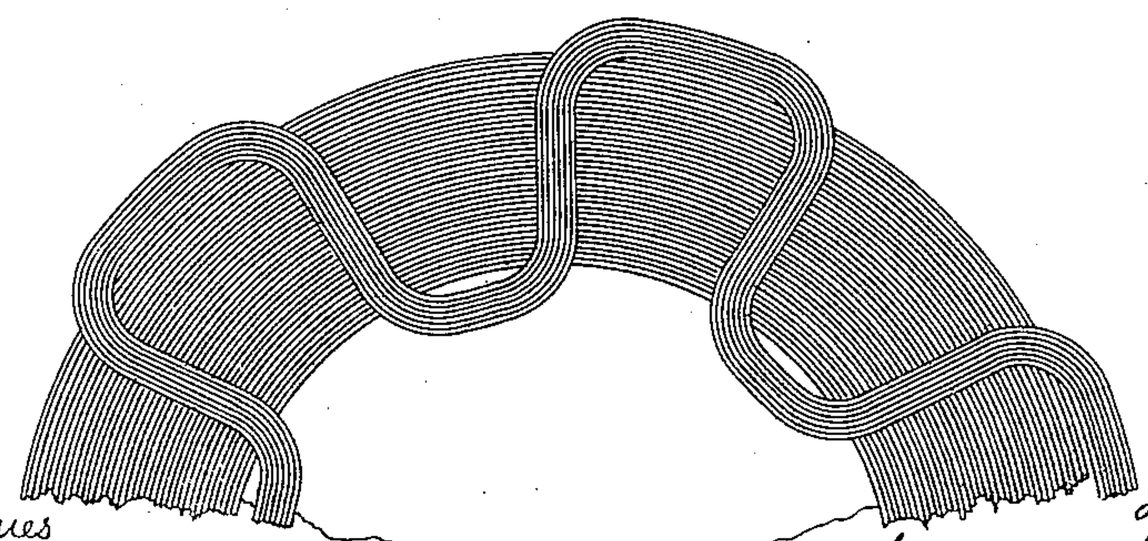


FIG. 4ª.



Witnesses.
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Inventor.
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Alex. Muirhead
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(No Model.) 3 Sheets—Sheet 2.

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FIG. 5.

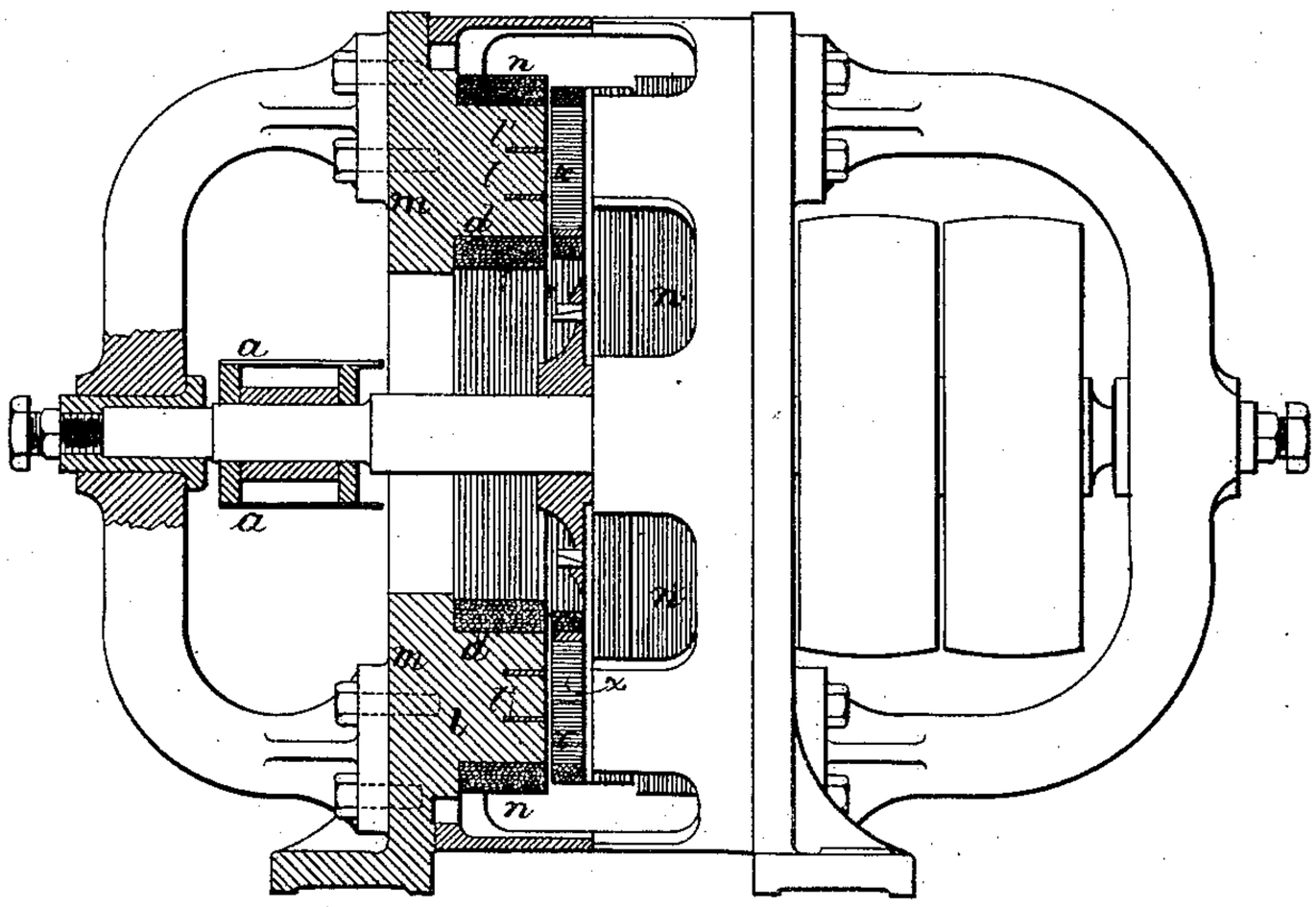

FIG. 6.

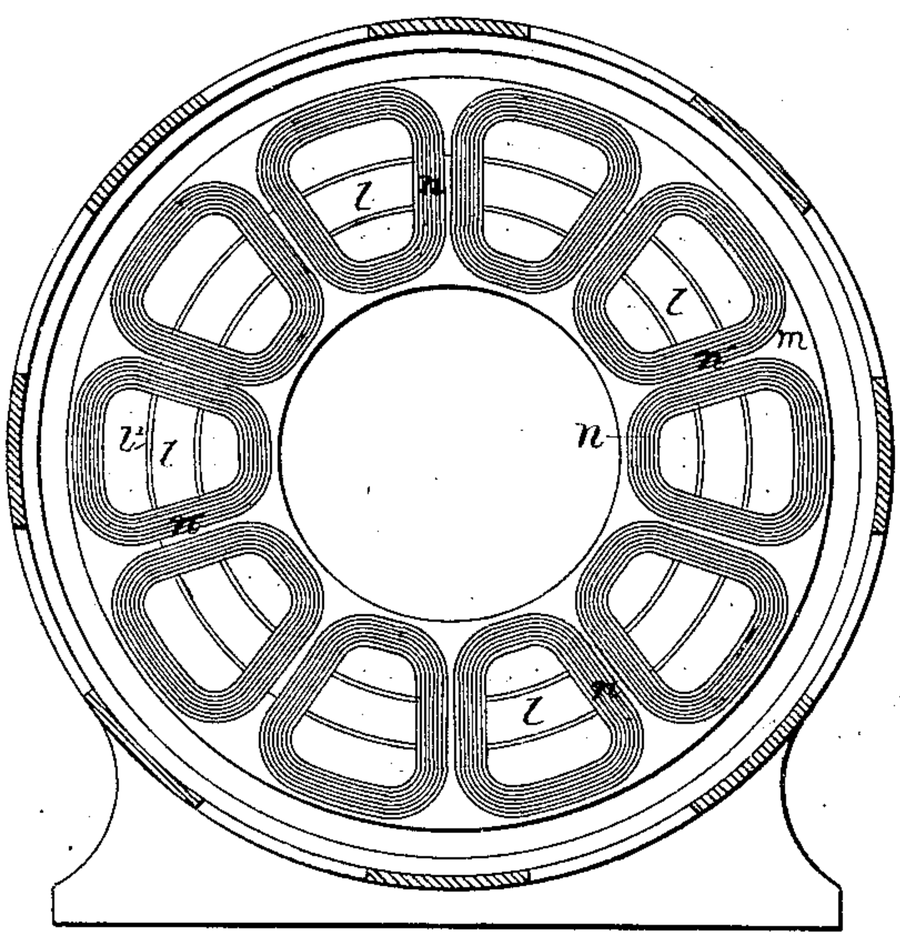

FIG. 7.

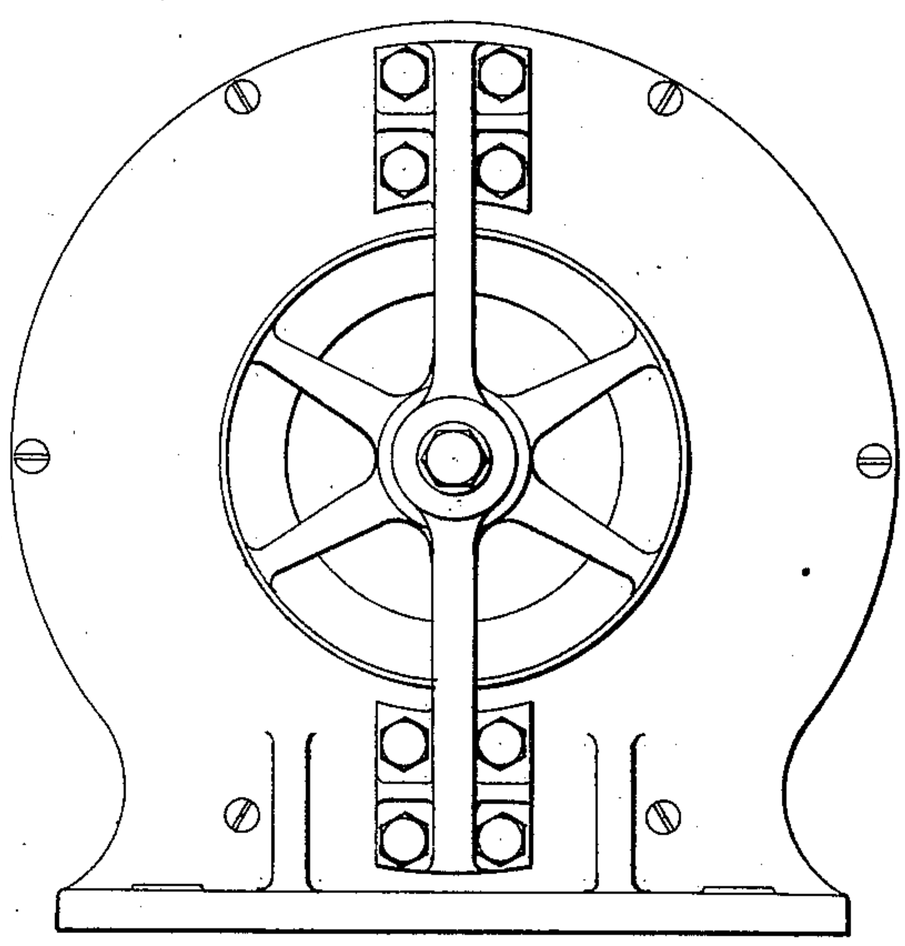

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FIG. 8.

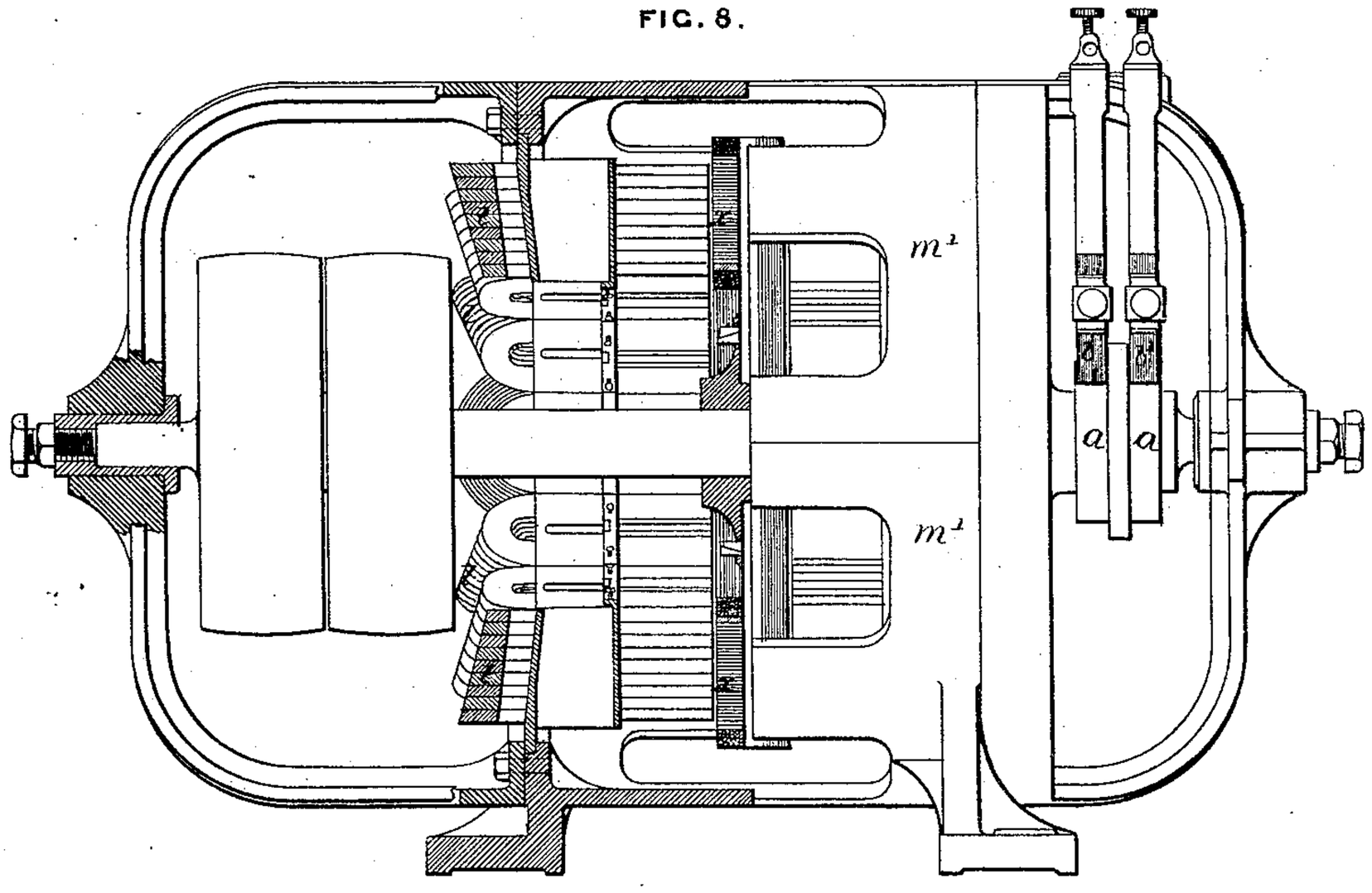


FIG. 9.

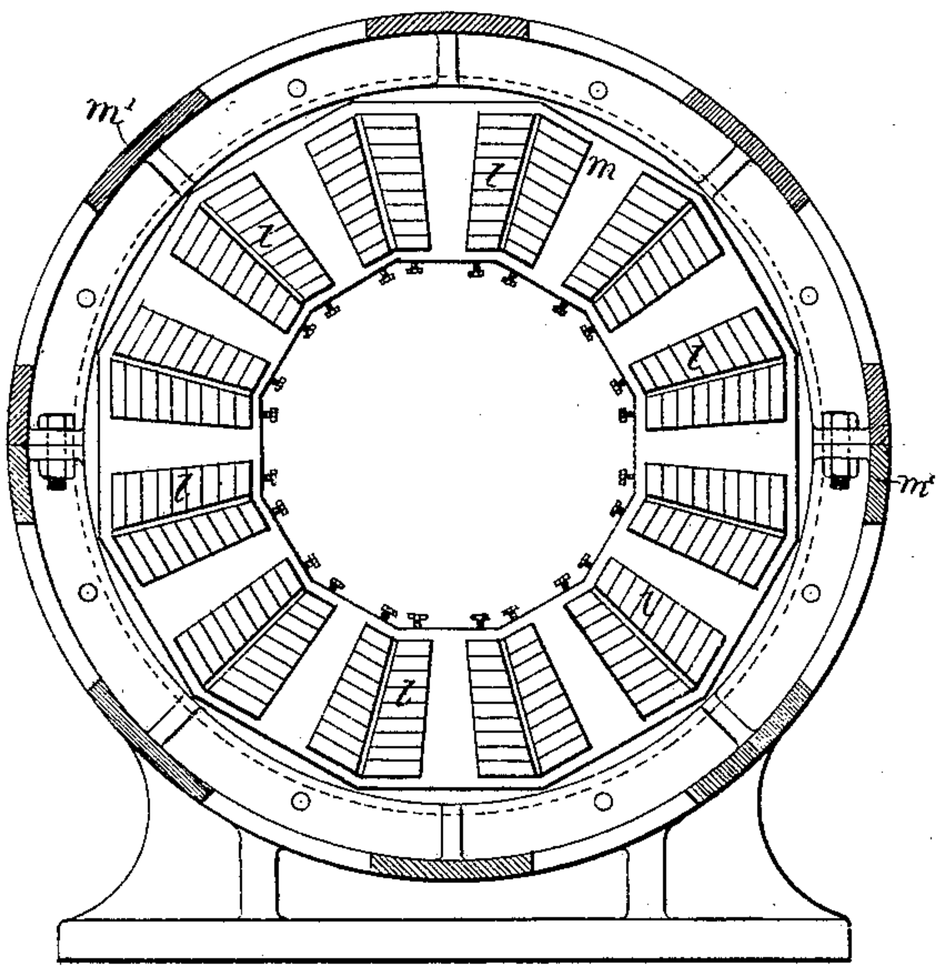
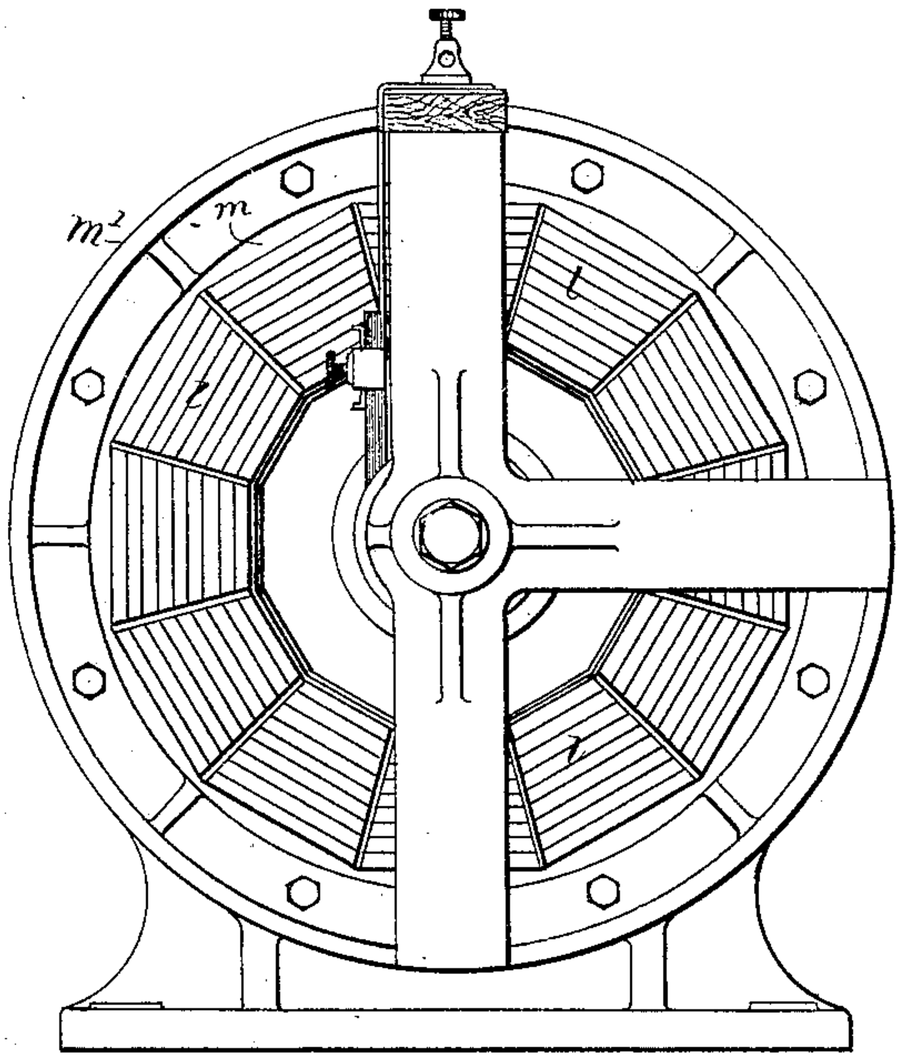


FIG. 10.



Witnesses.
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UNITED STATES PATENT OFFICE.

JOHN HOPKINSON AND ALEXANDER MUIRHEAD, OF WESTMINSTER, ENGLAND.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 280,039, dated June 26, 1883.

Application filed November 6, 1882. (No model.) Patented in England November 24, 1880, No. 4,886; in France May 21, 1881, No. 142,961, and in India December 5, 1881, No. 152.

To all whom it may concern:

Be it known that we, JOHN HOPKINSON and ALEXANDER MUIRHEAD, subjects of the Queen of Great Britain, residing, respectively, at 4 Westminster Chambers and 27 Regency Street, both in the city of Westminster, England, have invented certain new and useful Improvements in Dynamo-Electric Machines, (for which we have received Letters Patent in Great Britain, No. 4,886, dated November 24, 1880; in France, No. 142,961, dated May 21, 1881, and in India, No. 152, dated December 5, 1881,) of which the following is a specification.

This invention has for its object improvements in dynamo-electric machines. To reduce the sparks which occur between the commutator and the collecting-brushes, we divide the collecting-brush into parts, and that part which is latest in contact with any section of the commutator passes the current through a resistance, thus gradually checking the current as the contact is broken. The same effect may be obtained by interposing equivalent resistances in the commutator itself. Where the arrangement of the machine is such that the armature-coils lie in planes parallel or nearly parallel with the plane of revolution of the armature, we construct the armature thus: The circumference of a pulley is surrounded with a series of layers of sheet-iron insulated more or less completely from each other. On one or both sides of the ring thus formed radial slots are cut to admit the coils of insulated wire, which thus lie in planes parallel with the plane of revolution of the pulley. When a continuous current is required, we place coils on both faces of the armature and arrange them alternately, so that when one coil is at its dead-point those near to it on the opposite face are producing their maximum effect. The field-magnets are made in a manner similar to the armature, though not necessarily with precisely the same number of coils; but it is cheaper to make their cores of solid wrought-iron. In some cases we construct them of cast-iron. It is advantageous to cut grooves in the face of the iron and to fill up the grooves with insulated sheet-iron, so stopping the local currents in the cores, which would otherwise occur. Both in the armature and in the magnets we pack each coil close against its neighbor. Each coil is thus of approximately quadrilateral form.

In order that our said invention may be most fully understood and readily carried into effect, we will proceed to describe the drawings hereunto annexed.

In the drawings, Figures 1 and 2 show a convenient method by which, according to our invention, to reduce the sparks which occur between the commutator and the collecting-brushes in continuous-current machines. *a a a* are the segments of the commutator, insulated from each other. *b' b b* are the collecting-brushes or their equivalents, carried on a spindle, *c*. One of these brushes, *b'*, is arranged in such wise that there is an electrical resistance between the brush *b'* and the spindle *c*. This resistance may be made in various ways; but we prefer that shown in Fig. 2 of the drawings. *d e* are metal cylinders. To *d* the brush is attached, while *e* is in contact with the spindle *c*. The space *f* between *d* and *e* is filled with a mixture of plumbago and lamp-black having a suitable resistance. The ends of the space *f* are closed with disks of ivory. The brush *b'* is so adjusted, by lengthening, or as shown in Fig. 11, or otherwise, that it remains in contact with any segment of the commutator for a short space after the other brushes have left contact with that segment. The effect is that, instead of sudden rupture of the continuity of the armature-circuit connected to the segment of the commutator, a resistance is first introduced, and contact is not broken till the current has been in some measure reduced. For the more convenient adjustment of the machine, we provide several sets of brushes having different resistances, and we ascertain by trial and use that which gives the best result. Instead of interposing a resistance between the brush *b'* and the spindle *c*, the commutator-plate may be divided into two parts separated by an appropriate resistance, as illustrated in Fig. 11. It is clear that the electrical effect will be the same as in the plan more particularly described, and which we prefer. The collector or commutator which is used when

a continuous current is desired we make with the metal pieces to which the wires of the armature are connected air-insulated. The metal pieces are carried on insulating-disks at their ends, only having air-insulation in that part on which the collecting-brushes or their equivalents rub.

Figs. 3 and 4 show the armature we use in machines arranged so that the coils lie in planes parallel or nearly parallel with the plane of revolution of the armature. *g* is a pulley to be keyed on the shaft of the machine. It is surrounded by a series of layers, *h*, of sheet-iron, more or less insulated from each other. In one or both faces of this ring of layers of iron radial slots are cut for the reception of the coils of insulated wire *i*. The best method of fixing the layers of iron we believe to be the following: On the pulley we coil a band of sheet-iron and of asbestus paper, so that the asbestus paper separates the successive layers of iron from each other. When a sufficient thickness has been obtained, radial holes are drilled and bolts *k* are inserted and secured by the cotters *k'*. If the bolts are put in and cottered hot, the layers of iron and paper are very firmly nipped onto the pulley. The radial slots may now be cut. The figures show the armature as arranged for a continuous current—that is, with the slots on one side half-way between the slots on the other side of the armature. This is done in order that the current may be more approximately continuous; but when an alternating current is desired the slots in the opposite faces correspond. The connections of the coils with each other may be varied according to the electromotive force desired, as is usual and well understood. Although we prefer to insulate the layers *i* the one from the other by asbestus paper, the same result will be in part attained by painting the iron composing the layers, and even were the layers superposed without any such precaution a better result would be obtained than when the armature is made solid and not stratified, as described. In place of winding in the manner shown at Fig. 4, the winding may be in zigzag form, as is illustrated by Fig. 4ª.

Figs. 5, 6, and 7 show a complete continuous-current machine. *x* is the armature, already described. *l l* are the cores of the electro-magnets, with a strong cast-iron backing, *m m*. The cores are grooved, as shown at 1, and the grooves are filled with sheet-iron, either painted or insulated with asbestus paper. *n n* are the exciting-coils, the connections of which are so arranged that the poles are alternately north and south, and so that opposite to each north pole we have a south pole. *a* is the commutator. In place of forming the cores of the electro-magnets of cast-iron, they may be made from sheet-iron coiled and more or less insulated, and slotted to receive the coils, as described in respect to the armature.

The framing of the machine will be understood by inspection of the drawings.

Figs. 8, 9, and 10 show a complete alternating-current machine with permanent magnets. *x* is the armature. *l l* are the steel magnets, carried in two brass frames, *m m*, attached to the cast-iron frame *m' m'*. *a a* are the terminals of the armature-coils, on which press the collecting-brushes *b b'*.

Having thus described the nature of our invention and in what manner it is to be carried into effect, we claim—

1. The combination of a dynamo-electric machine, a commutator, a commutator brush or finger, and a resistance which is introduced into the circuit of the commutator-brush before contact is broken with the commutator-plates.

2. The combination, substantially as set forth, of the commutator-plates, the contact-fingers, the shaft on which they are carried, the elongated contact-finger, and the resistance interposed between the shaft and said finger.

3. The combination of an armature plate or disk composed of superposed rings or layers of iron formed with radial grooves or channels therein, and the armature-coils which are laid in said grooves, substantially as set forth.

4. The combination of an armature disk or plate composed of superposed rings or layers of sheet-iron with insulating material between them, and having radial grooves or channels in its face, with the armature-coils placed in said grooves in planes perpendicular, or nearly so, to the axis of rotation, substantially as set forth.

5. An armature-disk composed of superposed layers or rings of iron, and having radial grooves in its face, substantially as illustrated in Fig. 4ª, in combination with the armature-wires wound in a zigzag manner or laid in the grooves, substantially as illustrated in said figure.

6. The herein-described magnet-core, formed with slots or grooves in its face, in which insulated pieces of iron are inserted, for the purpose set forth.

7. The combination, substantially as set forth, of the armature-pulley, the superposed layers or rings of sheet-iron, the armature-coil, wound or laid in grooves formed in the face of the superposed sheet-iron layers, and the bolts *k*, which hold the layers of iron together.

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