(No Model.)

4 Sheets—Sheet 1.

M. W. LONG.

ELECTRIC MOTOR.

No. 501,842. Patented July 18, 1893.

Fig. 1 on line 1—1

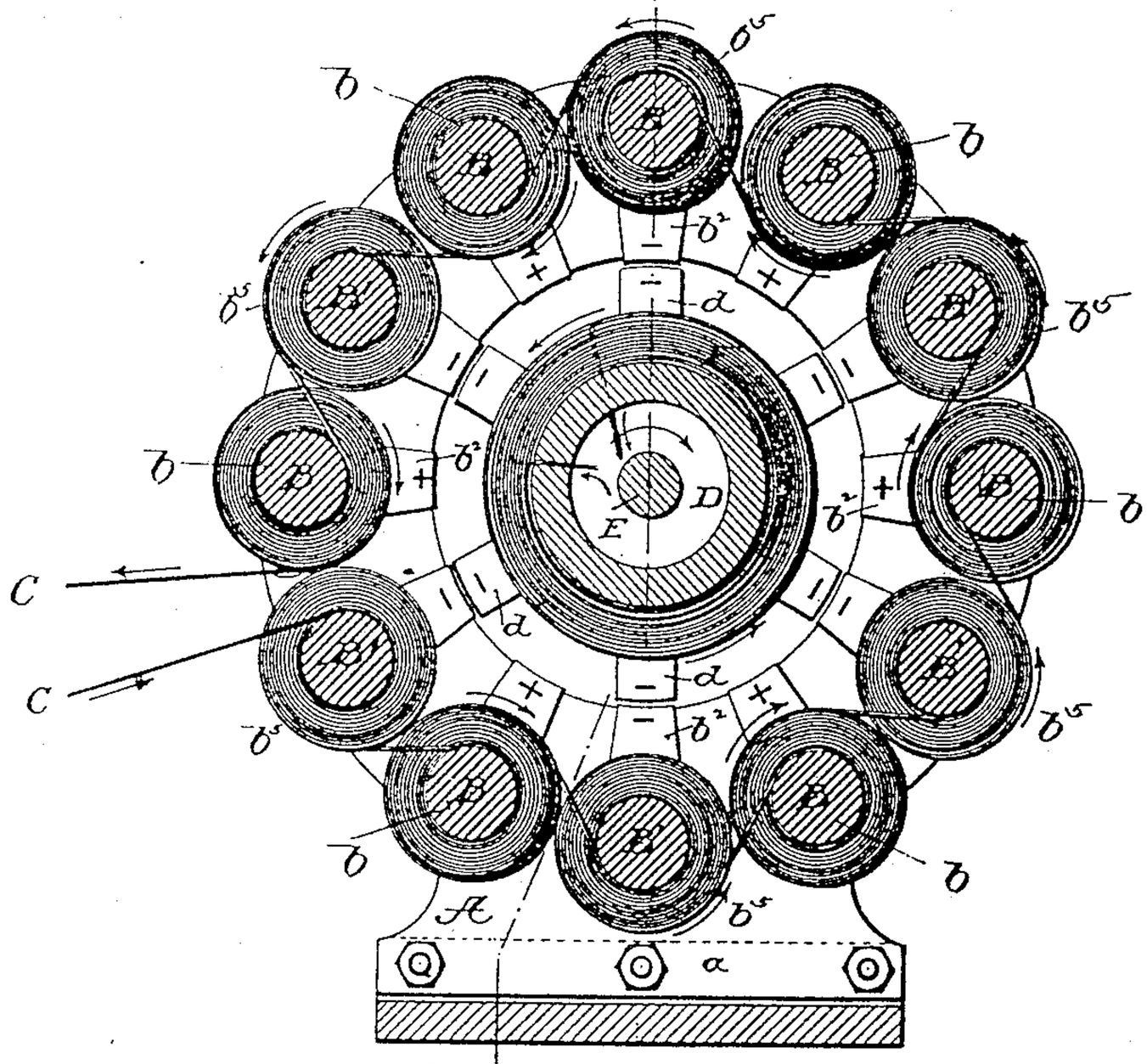
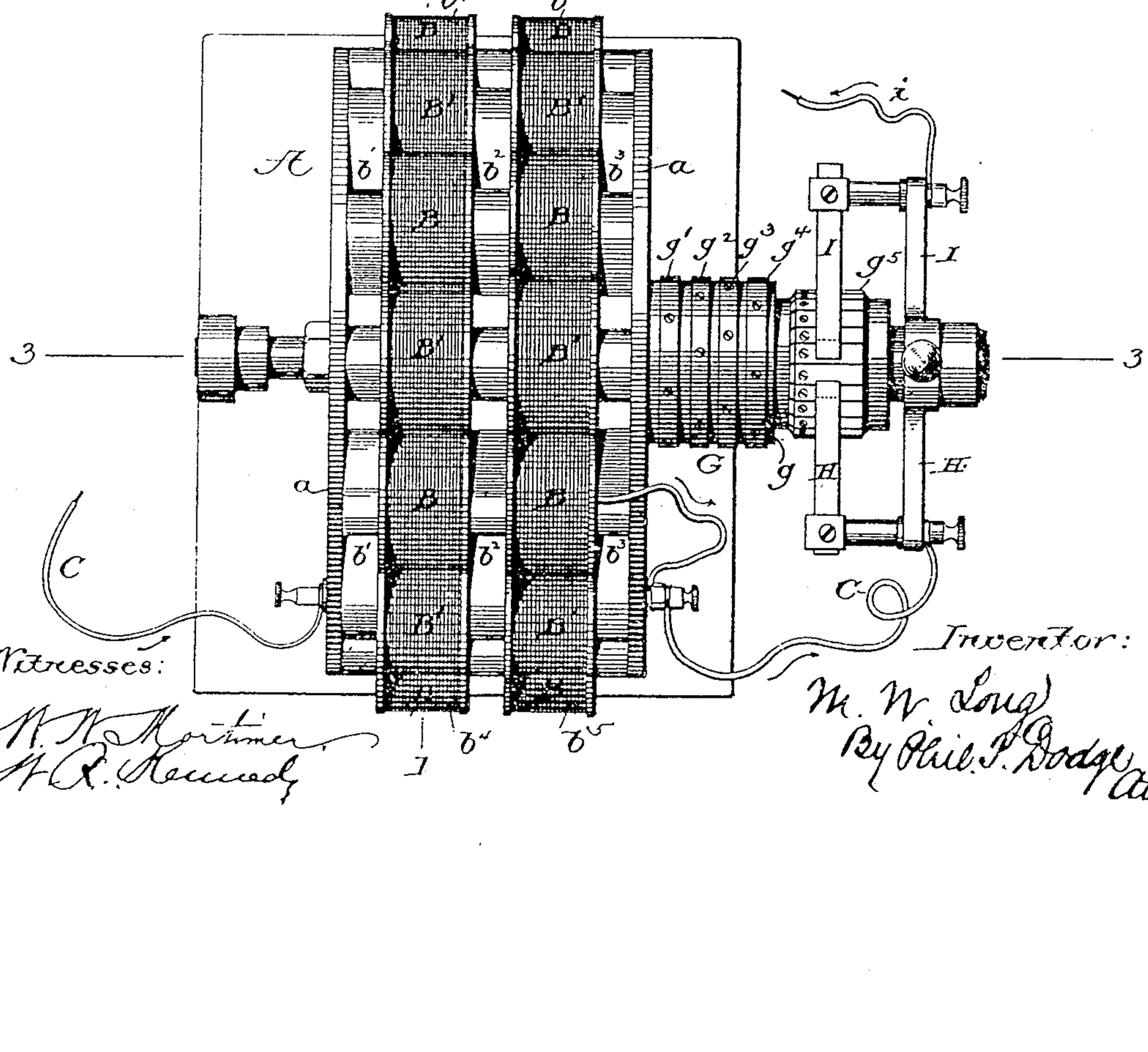


Fig. 2.



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By Chas. P. Dodge Atty

(No Model.)

4 Sheets—Sheet 2.

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ELECTRIC MOTOR.

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Fig. 3.

on line 3—3

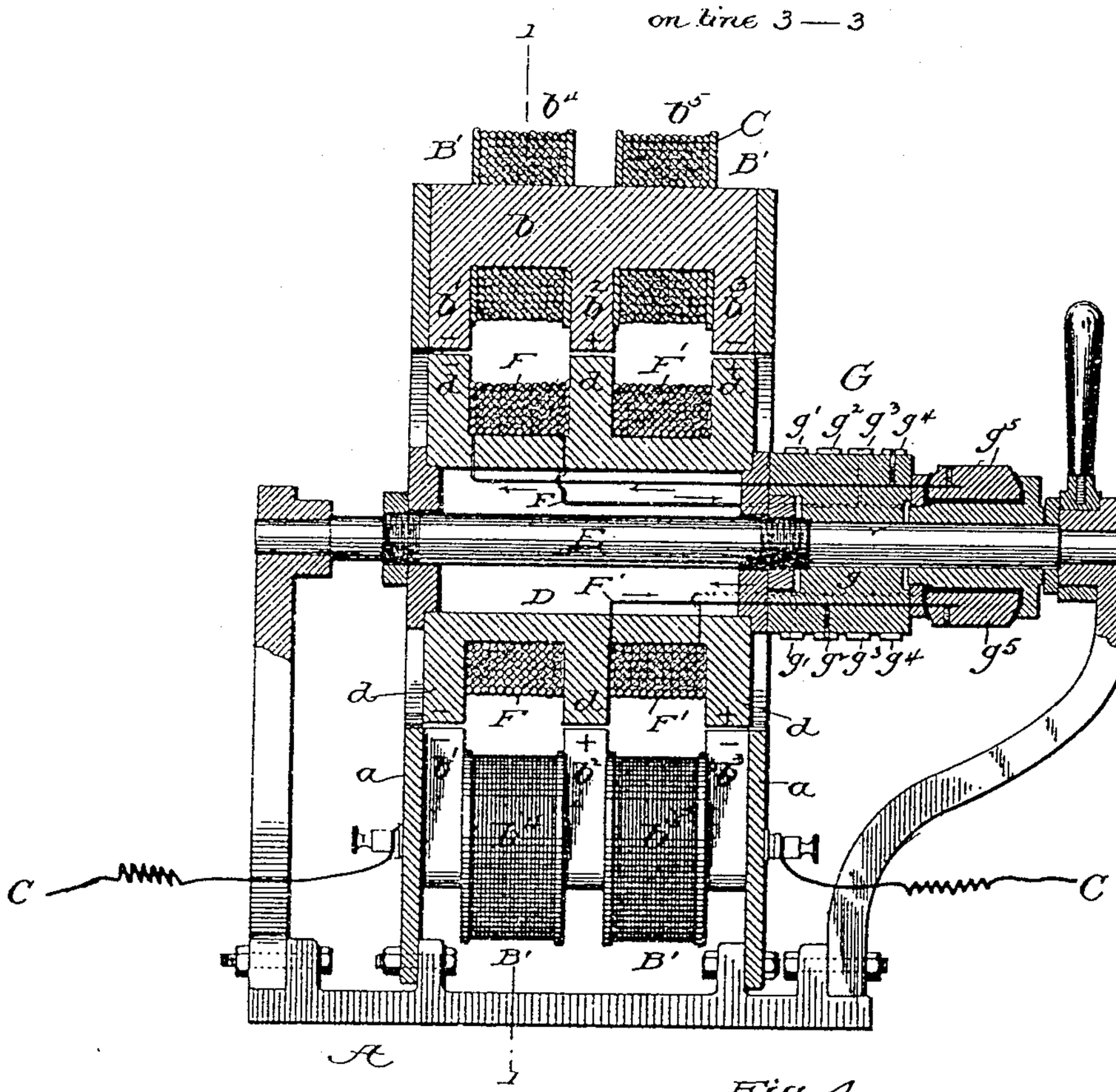
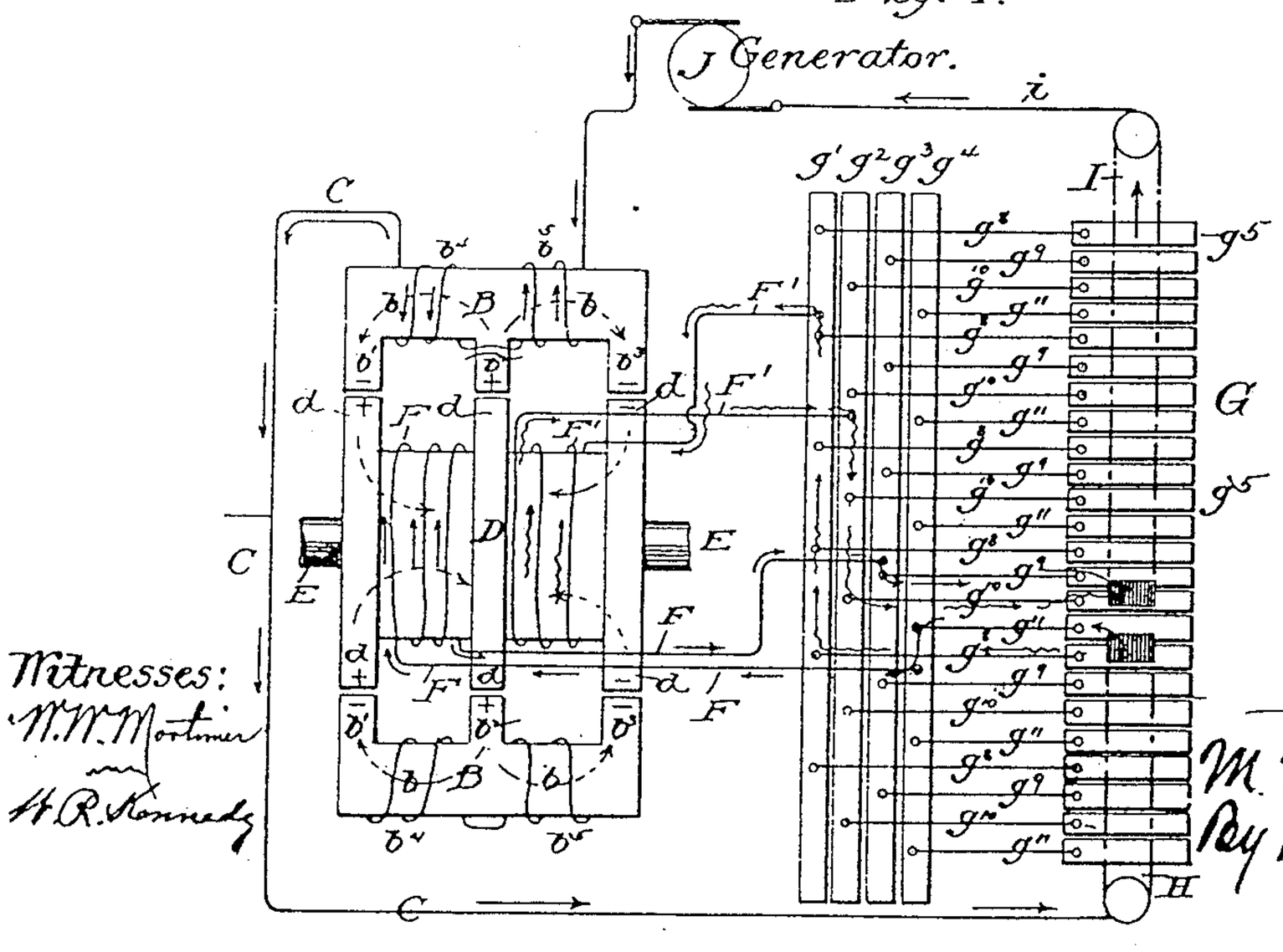


Fig. 4.



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(No Model.)

4 Sheets—Sheet 3.

M. W. LONG.

ELECTRIC MOTOR.

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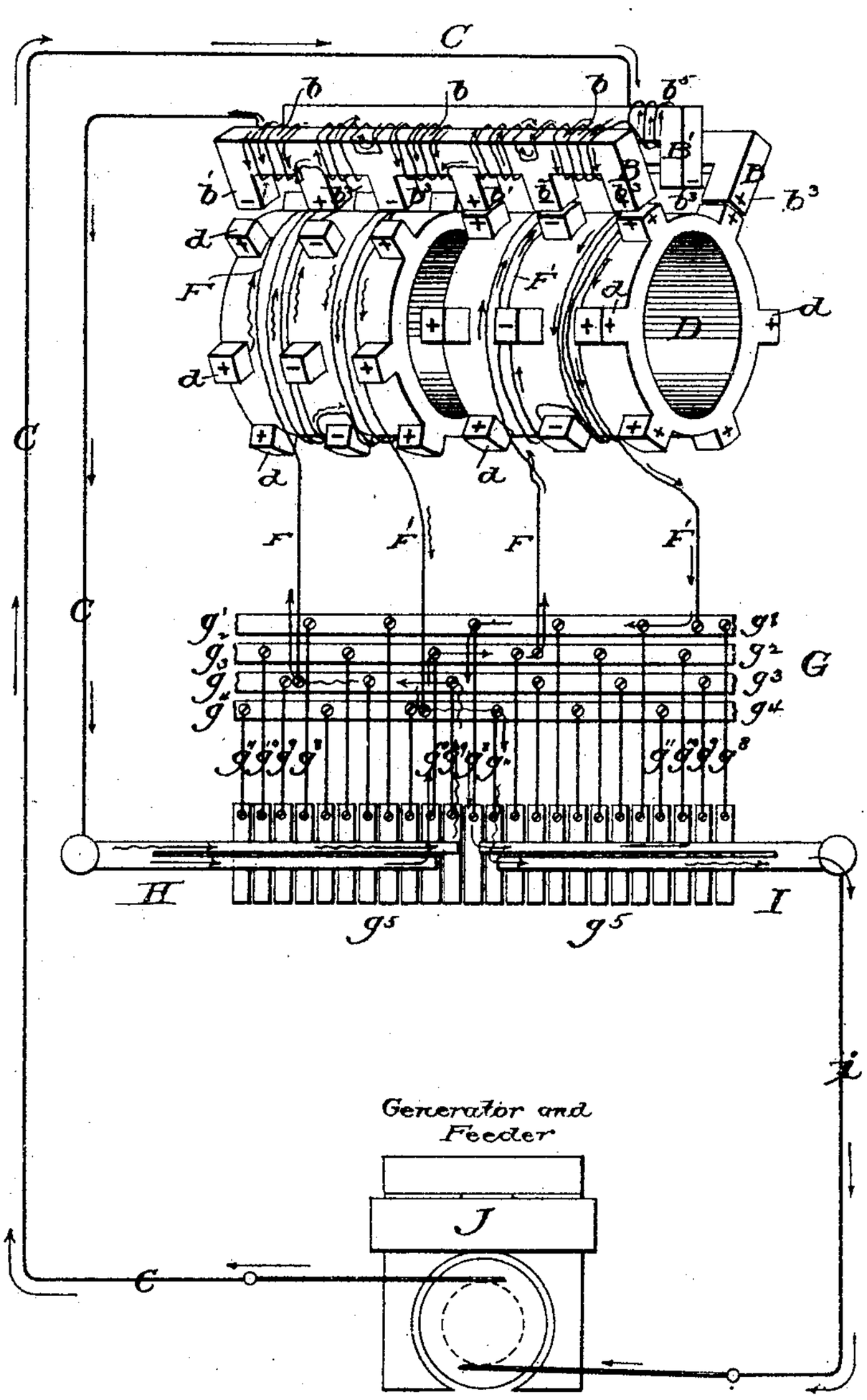
Fig. 5.



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(No Model.) 4 Sheets—Sheet 4.

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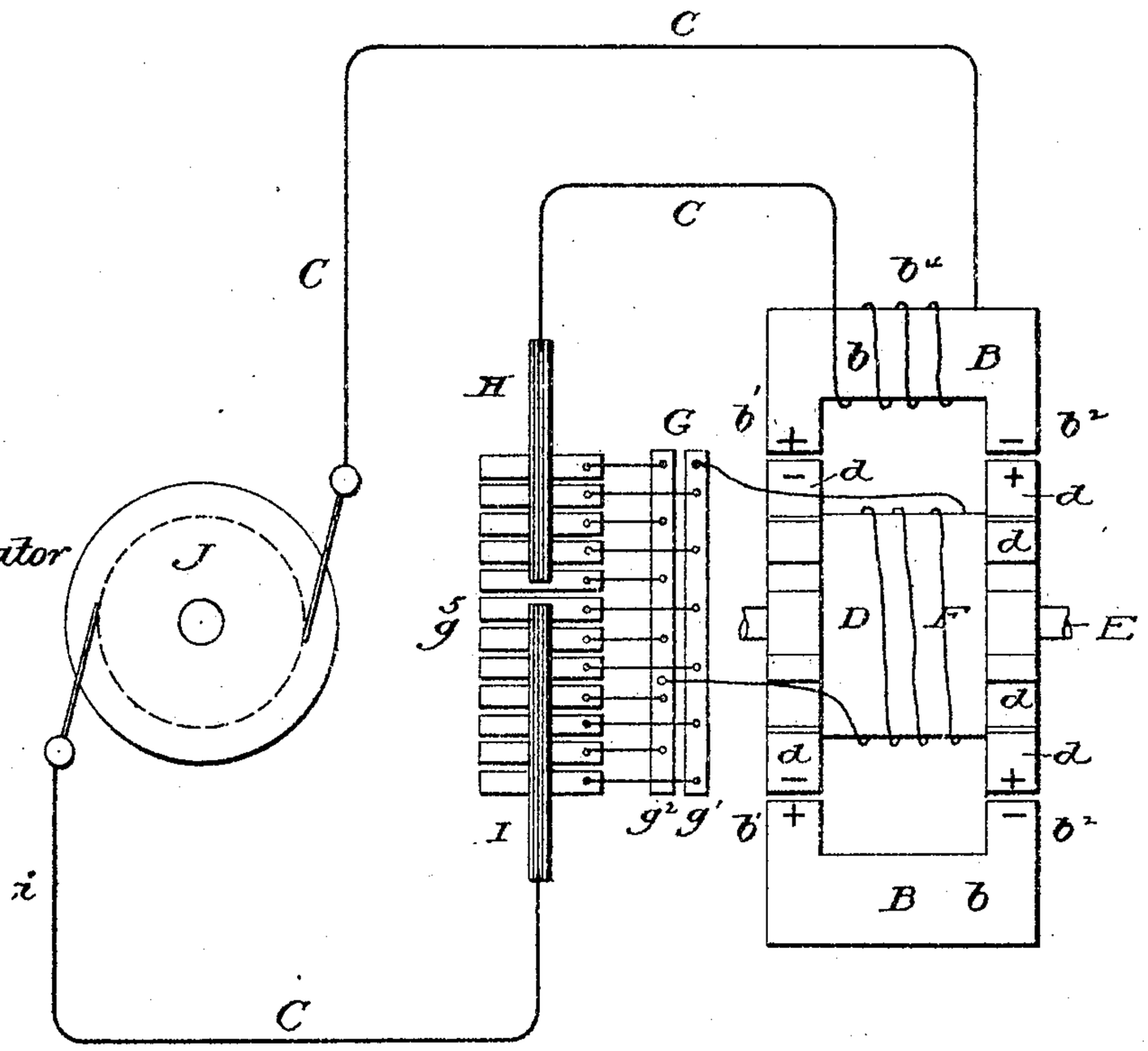
ELECTRIC MOTOR.

No. 501,842. Patented July 18, 1893.

Fig. 6.



Witnesses:

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F. R. Kennedy

Inventor:

M. W. Long

By his Atty

Phil. T. Dodge

UNITED STATES PATENT OFFICE.

MALCOLM WALLACE LONG, OF HARRISBURG, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO THOMAS W. SNOW, OF BATAVIA, ILLINOIS.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 501,842, dated July 18, 1893.

Application filed March 23, 1891. Serial No. 386,162. (No model.)

To all whom it may concern:

Be it known that I, MALCOLM WALLACE LONG, of Harrisburg, in the county of Dauphin and State of Pennsylvania, have invented certain Improvements in Electric Motors, of which the following is a specification.

The aim of my invention is to provide an inexpensive and efficient motor which may be operated by either a continuous or an alternating current as occasion may demand. To this end I employ in combination with armature magnets each of alternating polarity, an annular series of field magnets of unchanging polarity, each of opposite polarity to the next. The individual magnets may be modified in form, the grouping changed, and the commutator varied, provided the characteristics above named are retained; but in the drawings I have shown the details of construction which I find best adapted for use under ordinary conditions.

In the accompanying drawings,—Figure 1 is a vertical section through the motor, in a plane transverse to the axis of rotation, on the line 1—1 of Figs. 2 and 3. Fig. 2 is a top plan view of the motor. Fig. 3 is a vertical axial section on the line 3—3 Figs. 1 and 2. Fig. 4 is a diagram showing a development or plane projection of the commutator and circuit connections. Fig. 5 is a diagram showing the motor on a larger scale with the commutator and connections developed on a plane, and the other parts in perspective; Fig. 6 a view illustrating the motor in its most simple form.

A represents a rigid frame having vertical side plates *a*, which sustain the horizontal field magnets B B′, arranged in an annular series. Each of these magnets consists of a horizontal core or body, *b*, with the three poles or faces *b′*, b^2 and b^3, extending inward from the two ends and the middle respectively, and of the two insulated coils b^4 and b^5 encircling their respective ends in reverse directions.

I commonly wind the entire series of field magnets with one continuous wire, C, coiling the same around one end of the first magnet then in the reverse direction around the opposite end of the same magnet as shown in Fig. 4, and so on repeatedly around the successive magnets, taking care to wind each magnet in the reverse direction from those which are next adjacent. In this manner the magnets are caused to present in the same vertical plane successively positive and negative poles as indicated in the drawings by the symbols thereon. As will hereinafter appear the inciting current is passed uninterruptedly through all the field magnets, so that their polarity and attractive energy remain unchanged.

D represents the rotary armature made preferably in one piece of tubular form and mounted on a rotary shaft E, seated in fixed bearings in the frame as shown. The armature is formed with circumferential flanges at the two ends and the middle, and these flanges are divided or cut away at the periphery in such manner as to leave the projecting poles or faces *d*, which as the armature is rotated travel in circular paths past the corresponding poles of the field magnets. The two ends of the armature are wound circumferentially in the channels between the flanges, with insulated wires F F′, coiled in opposite directions, and receiving their currents in such manner that all the poles at each end of the armature are of the same polarity but of opposite polarity to those at the other end.

The armature is preferably made, as shown, with one half the number of poles that there are field magnets, and its coils are so connected with the commutator that each armature pole has its polarity reversed as it passes from each field magnet to the next. The commutator or current changer may be of any ordinary or suitable construction to this end, but on account of its simplicity I prefer the construction illustrated in Figs. 2, 3 and 4, in which G represents the commutator. A non-conducting hub, *g*, fixed on the shaft carries four parallel unconnected conducting rings *g′*, g^2, g^3 and g^4, and an adjacent hub carries unconnected insulated conducting plates g^5, twice as many in number as the field magnets. Two insulated conductors or brushes H and I, extend inward from binding posts, and rest upon the plates g^5, at a distance apart about equal to the width of one plate, although this distance may be slightly varied. The brush H is connected to one end of the field magnet wire C, which after encircling

the magnets extends to the dynamo J, or other source of electric supply, which latter is also connected by wire *i*, with the second brush I. The armature coil F has one terminal connected permanently to ring g^3, and the other connected to ring g^4; while the second armature coil F′, is connected at one end to ring g', and at the other to ring g^2. The four rings are connected successively by conductors g^8, g^9, g^{10} and g^{11}, respectively with the different plates g^5, as shown in Fig. 4; that is to say, the four rings are connected successively with four successive plates, and the connections then repeated with the next four plates and so on throughout the series—each ring being connected with every fourth plate. The result of this combination is that the current passes as shown by unbroken arrows, from the generator through the field magnets B, B′ to brush H, and thence in part through one of the plates g^5, and the connected ring to the armature coils F and thence back through another ring and plate to the second brush I, to the generator. This causes the armature poles to present the opposite polarity from the field magnets toward which they are advancing. As the armature revolves and its poles are brought opposite the field magnets the commutator brushes act upon the next plates and direct the course of the current through the armature coils F′, reversing the polarity of the armature poles so that they are attracted by the next field magnets—the polarity of the latter remaining unchanged.

Inasmuch as the current through the field magnets is practically constant and unchanging, it is not necessary that it shall pass through the commutator, as it may pass through a shunt from the main circuit without entering the commutator. The construction shown is preferred because of the simplicity and of its securing a proper distribution between the field and armature magnets. If the shunt circuit to the field is used the rings g' and g^2 may be omitted and the bars connected to the rings g^3 g^4 alternately in order to reverse the current through the armature as indicated in the diagram Fig. 6.

While I prefer to construct the field magnets and armature each with three poles as described the number may be increased or diminished.

In Fig. 5 I have shown the field magnets each with six poles and five reversely wound coils, and the armature with a corresponding number of series of poles and four coils. The poles on one end of the armature are set slightly in advance of those at the other end, and each of the commutator brushes divided and its ends extended one beyond the other, so that they lie on adjacent plates. The two coils on each end of the armature are reversely wound from a single wire and the ends of these wires connected to the commutator rings in the same manner as in the first example. The advantage of this arrangement lies in the fact that there is a more rapid succession of active poles, or in other words, a more nearly continuous pull of the magnets than in the first arrangement.

Having thus described my invention, what I claim is—

1. In an electric motor, the series of field magnets of unchanging polarity and each of opposite polarity from the next, in combination with the armature having the poles at each end of the same polarity, and a commutator for automatically reversing the polarity of the armature as it revolves.

2. In combination with the series of field magnets each of opposite polarity from the next, the armature having all the poles at each end of like polarity, the commutator rings having the magnet coils connected thereto as described, the commutator plates, and the two brushes contacting with the plates.

3. The fixed magnets each with two end poles and an intermediate consequent pole, the continuous wire oppositely wound on the successive field magnets and reversely wound on opposite ends of each magnet, in combination with the armature having the three annular series of poles, the coils reversely wound on the two ends of the armature, the four rings connected with the field and armature coils, as described, the commutator bars connected to the respective rings and the commutator brushes.

4. In an electric motor the series of field magnets of unchanging polarity, each of opposite polarity from the next, the armature having at each end a series of poles of the same polarity, the two series being of opposite polarity, a coil wound on the armature, and means for reversing the direction of the current through said coil.

In testimony whereof I hereunto set my hand, this 26th day of February, 1891, in the presence of two attesting witnesses.

MALCOLM WALLACE LONG.

Witnesses:
CHARLES H. BABB,
JAMES M. HOFFER.