(No Model.) 2 Sheets—Sheet 1.

J. O'NEIL.

ELECTRIC MOTOR.

No. 545,524. Patented Sept. 3, 1895.

FIG. 1.

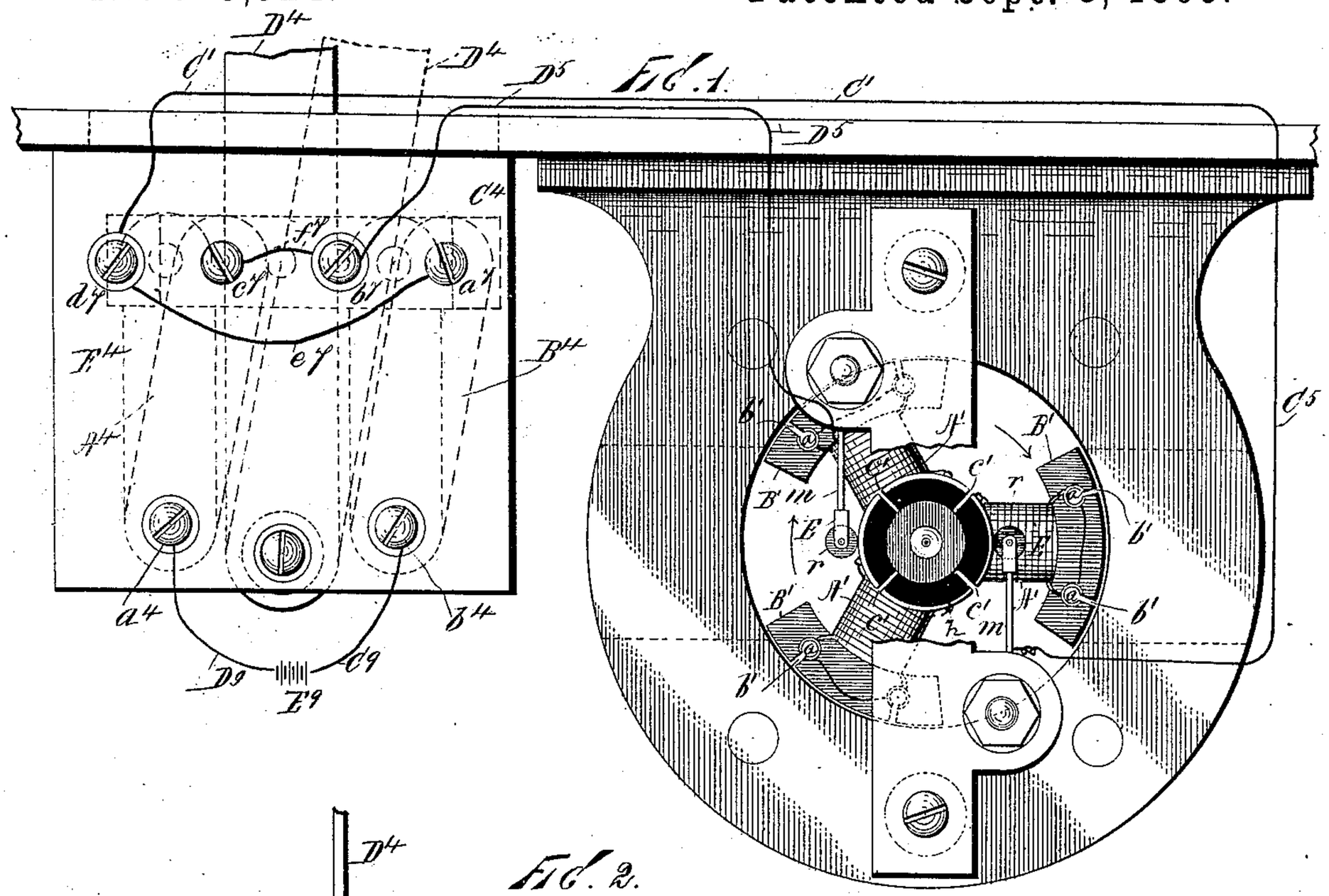

FIG. 2.

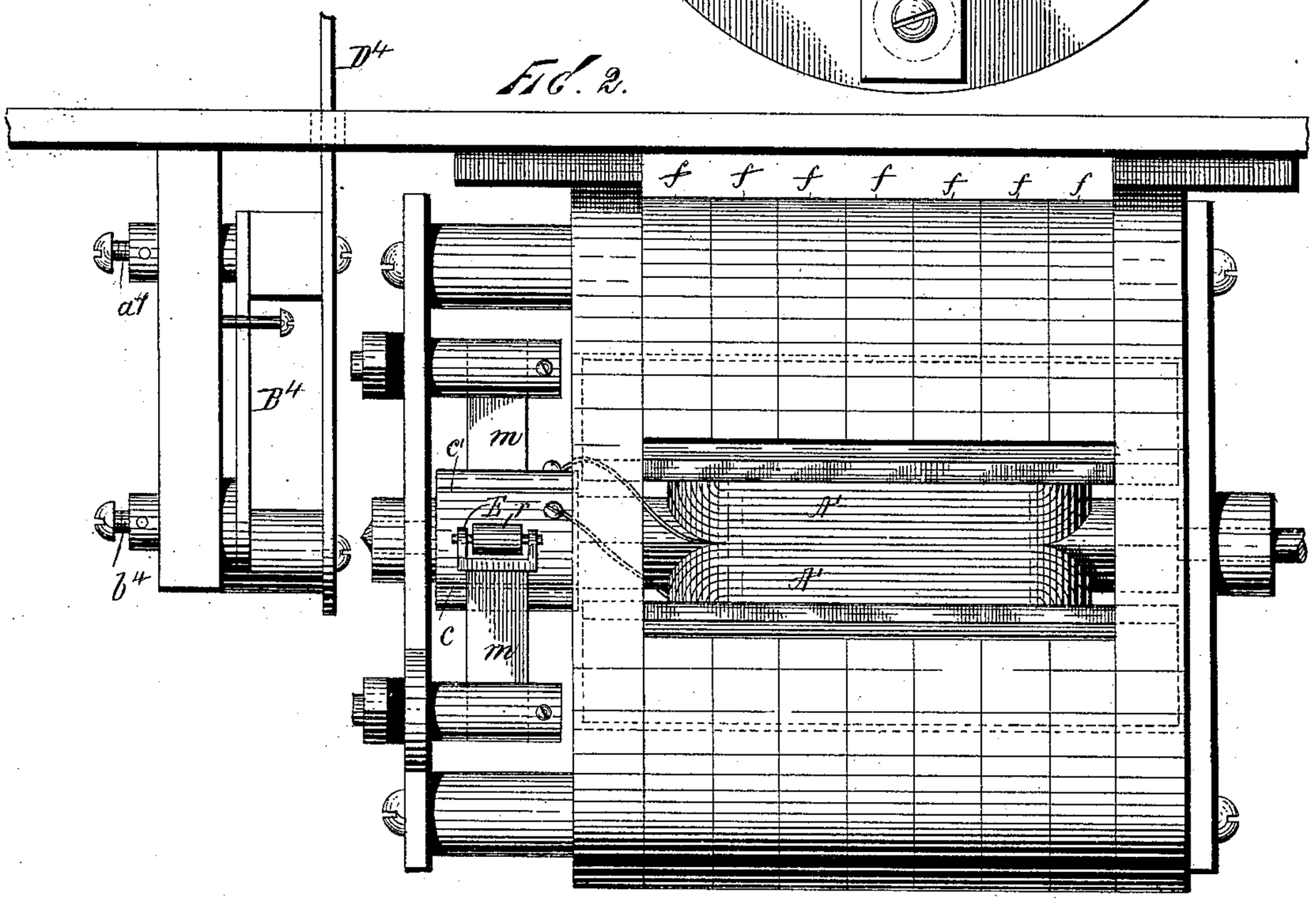

FIG. 3.

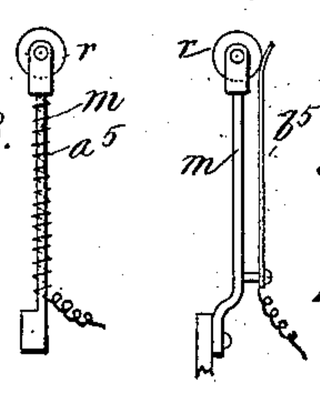

FIG. 3b.

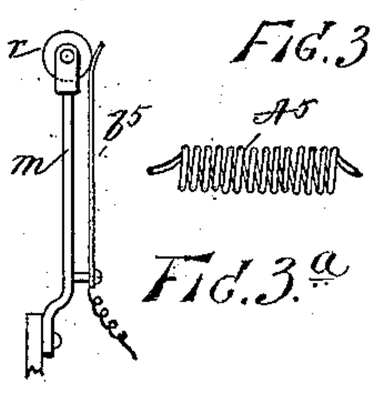

FIG. 3a.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

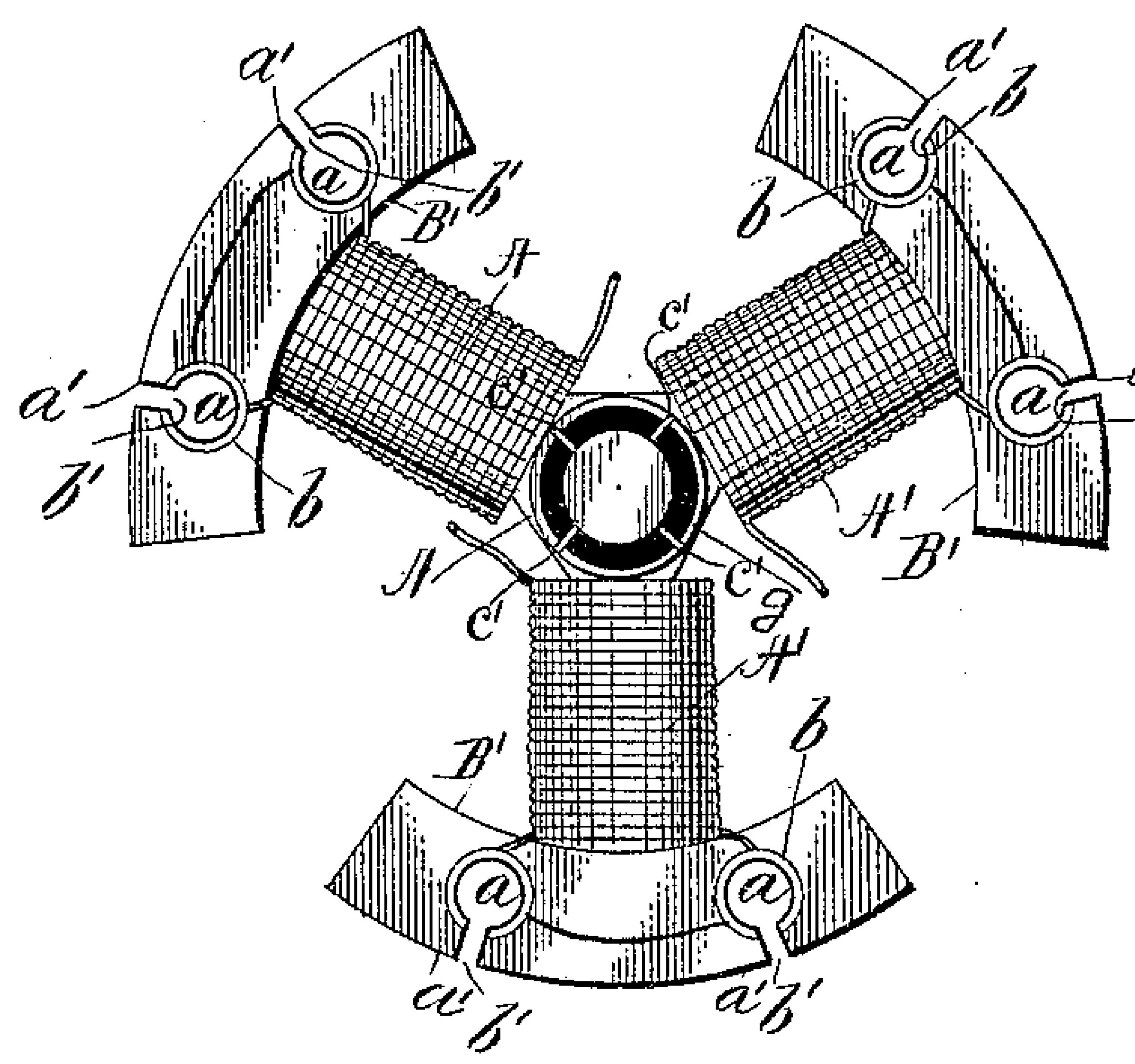


Fig. 5.

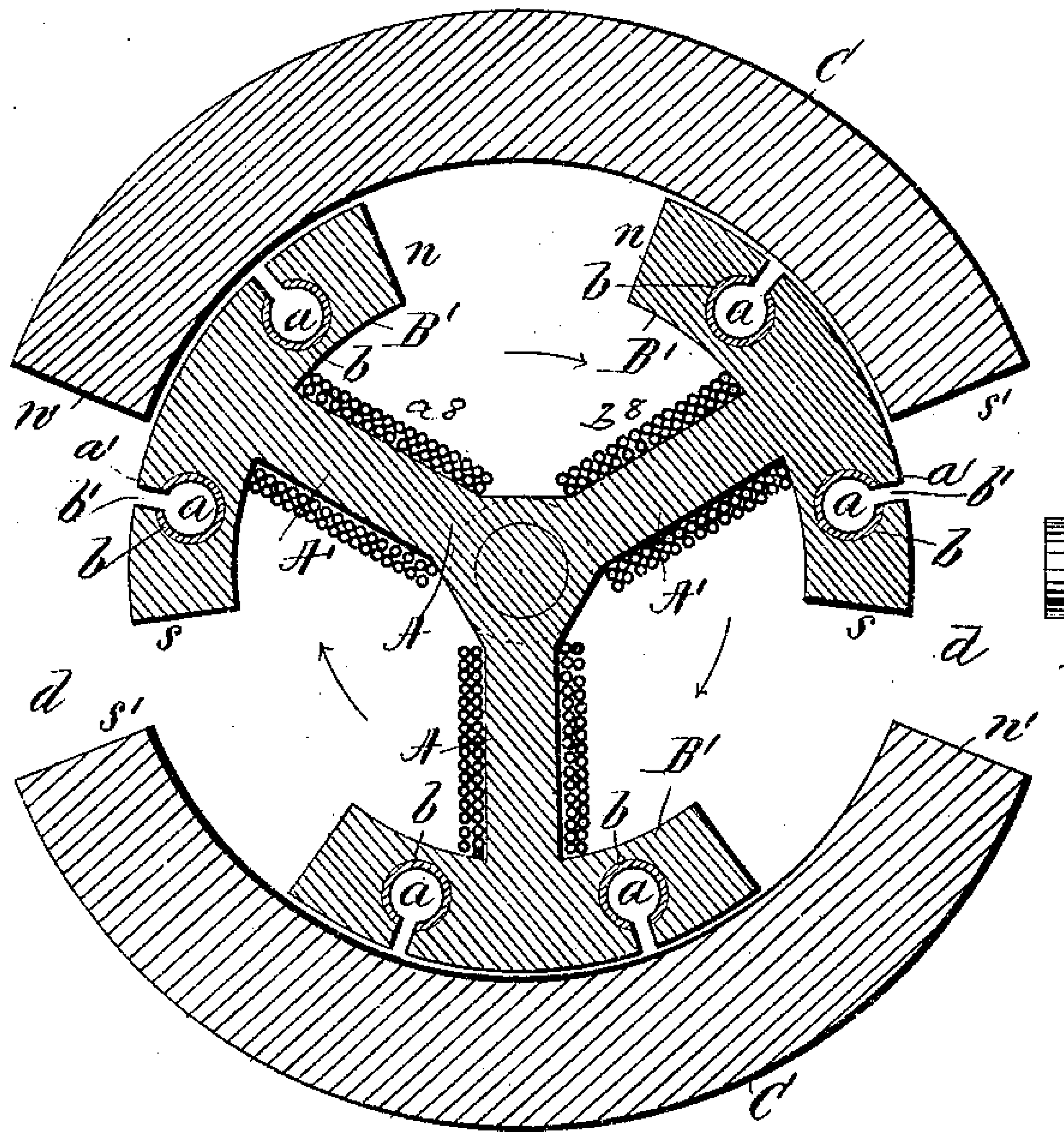
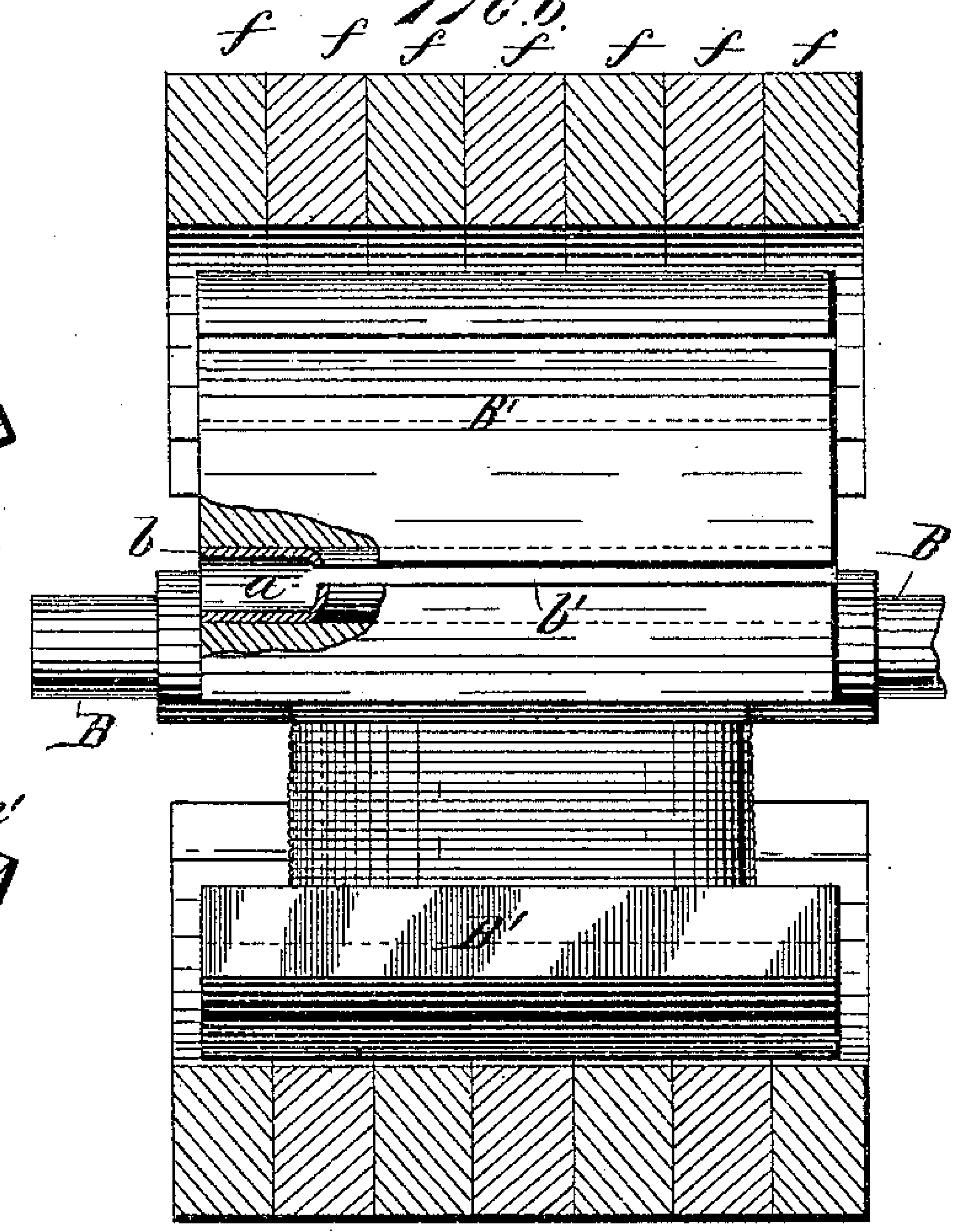


Fig. 6.



Witnesses:
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UNITED STATES PATENT OFFICE.

JOHN O'NEIL, OF NEW YORK, N. Y.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 545,524, dated September 3, 1895.

Application filed June 22, 1894. Serial No. 515,445. (No model.)

To all whom it may concern:

Be it known that I, JOHN O'NEIL, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Electromotors; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings, making a part of this specification, in which—

Figure 1 is an end view of a motor made according to my said invention. Fig. 2 is a side view thereof. Figs. 3 and 3^A are detached views illustrating certain features of my invention, and Fig. 3^B is a detached view of another device which may be used in the apparatus. Fig. 4 is a detached view of the armature employed in said motor and certain adjuncts thereof. Fig. 5 is a sectional view of certain parts of said motor in a plane transverse to the axis of motion of the rotative armature; and Fig. 6 is a sectional view of the same, taken in a plane longitudinal with said axis.

The object of this invention is to increase the utilization of electric energy in rotative electric engines and to promote the durability and add to the ease and smoothness of operation of this class of motors.

My invention comprises certain novel combinations of parts by which these results are effectually secured.

The armature A is fast upon a suitable shaft or other appropriate axial support B, which permits its rotation in either direction and which constitutes by its prolongation at one end the driving-shaft of the motor. Said armature comprises any desired number of radial arms A′, upon the outer end of each of which is an armature-head B′. The armature-heads are each shaped upon the arc of a circle, as shown more fully in Figs. 4 and 5, and are all concentric with the axis of motion of the armature and in the rotation of the latter follow each other in the same track. The radial arms A′ and their respective armature-heads B′ are of soft iron or steel, or, in other words, of material capable of becoming magnetic by due subjection to the effects of an electrical current. In each of the armature-heads, in direction parallel with the axis of motion of the engine, are any desired number—as, for example, two—of bores or openings *a*. Each of these bores is open at its outer side, as at *a′*, by means of a longitudinal slit extending from the interior of the bore to the outer surface of the armature-head, as shown in Figs. 4 and 5. In each of the bores *a* is a copper tube *b*, which, as shown at *b′*, is slotted lengthwise, its slot being coincident with the adjacent opening or slit *a′*.

Upon each of the arms A′ is wound a coil or helix *c* of conducting-wire. This wire, starting from the commutator which controls the electric current in the operation of the motor, is wound upon the arm, then connected with the copper tube *b* in one of the bores *a*, thence from the opposite end of said tube carried to the opposite end of that in the adjacent bore *a* of the same armature-head, and thence back to the commutator, by this means including the tubes *b* of the bores *a* in the magnetic circuits of the helix which energizes the armature-arm and its head. I greatly increase the magnetic effect of the armature-heads in the operation of the motor, the arrangement and combination of the parts as described contributing to the more rapid and effective magnetization of the said armature-heads, while the presence of the slits *a′ b′* promotes the demagnetization of said armature-heads, as the current through the armature-arms and armature-heads is alternately made and broken in the rotative operation of the motor.

The preferable mode of connecting the helix *c* with the copper tubes is by forming those portions of the helix which connect with said tubes of wire of less diameter than that which is coiled around the arm A′ and winding this finer wire into a close spiral of such diameter that said spiral may fit snugly within the same and in contact with the inner surface thereof. It is of course to be understood that each armature-head becomes in fact an electromagnet and that each, as such, has its "north" and "south" poles, so called. These are of course changed or alternated in position in each head with the changing of the current from the one direction to the other through the helix and tube of the head and its armature-arm. The poles of each armature are in-

dicated by the reference-letters *n* and *s* in the drawings.

Placed upon opposite sides of the armature A are two magnets C, with spaces *d* between their opposing ends. The north pole *n'* of each magnet is opposite the south pole *s'* of the other, as more fully shown in Fig. 5. Each of said magnets is curved arc-shaped and concentric, or substantially so, with the axis of motion of the armature A. Each is built of plates or sections *f*, placed side by side, as shown in cross-section in Fig. 6, and secured in such position by any suitable means, as, for example, by bolts or screws.

Placed concentric with and carried by the shaft B of the armature A are the metallic commutator-plates *g*, which are separated or insulated from each other, as indicated at *c'*. This insulation may be most conveniently obtained by providing a small space at *c'* between the adjacent ends of said plates, or, if preferred, by placing a thin strip of insulating material—such as mica—between their adjacent ends. Said plates are all insulated from the shaft B, and consequently from the arms A, by means of a suitably-fixed block *h*, of vulcanite or other insulating material, interposed between said plates and the shaft B and secured in position by any suitable means. The inner end of the helix *c* of each arm A is connected to the adjacent commutator-plate *g*. From each commutator-plate to the other extends a suitable conducting-wire. These wires are apart from the insulating-spaces *c'* between the commutator-plates.

The commutator-brushes are shown at E and F, respectively. Each comprises a spring *m*, of conducting material, and is provided at its free end with a bearing for a roller *r*, which is also of conducting material and which is pressed by the spring against the circumference of the adjacent commutator-plate. Each of the springs is connected with a wire from the battery, dynamo, or other source of electric energy in the manner usual with ordinary commutator-brushes, these wires being indicated by reference-letters C^5 and D^5, respectively.

When desired, the commutators may have either of the modified structures shown in Figs. 3 and 3^A. In the one of these the current is conducted to the same by coiling the conducting-wire around the spring *m*, as shown at a^5, in the other by attaching the said wire to a supplemental elastic leaf b^5, which rests against the rear surface of the roller *r*. In any case the roller is itself insulated either by insulating-bearings in the forked upper end of its supporting-spring or by suitably insulating the latter.

Instead of placing copper tubes in the bores of the armature-heads in the manner above described, I reach, when preferred, an equivalent result by coiling that portion of the wire extended or continued from the helix in the form of a cylinder, as shown at A^5 in Fig. 3^B, and thrusting the same into the bore in lieu of the copper tube. It will be noticed that whether the tube or the coil be used in either case the conductors placed in any one of the heads are connected with each other, as shown in outline in Fig. 1.

The operation of the apparatus is as follows: Assuming the right-hand conducting-wire C^5 to be from the positive pole of the source of electrical energy, the other conducting-wire D^5 is of course connected with the negative pole thereof. The rollers *r* being arranged opposite each other and the current a positive one, as described, it follows that, with the parts in the position shown in Fig. 5, the current will pass through the helices of the arms and armature-heads, (indicated in said figure at a^8 and b^8,) thereby giving to the said heads the polarities indicated by the letters *n* and *s*. The rollers *r*—in other words, the commutators—being so arranged with reference to the parts as to apply the current to those which connect to electrify the helices of the two upper armature-arms and armature-heads, as shown in Fig. 5, the lowermost arm and its commutator-head being demagnetized by being, for the time, cut off from the current, the pole *s* of the upper right-hand arm and armature-head will be attracted by the adjacent pole *n'* of the lower magnet C, while its opposite pole *n* is attracted by the pole *s* of the opposite or uppermost magnet C, and simultaneous with this the pole *s* of the upper left-hand arm and armature-head will be repelled by the pole *s* until it is brought within the influence of the pole *n'* of the other or upper magnet, which attracts it with a motion to the said armature-head in the same directions as before of the said lower magnet, these causes conjoining to rotate the armature for almost the one-third of a revolution, whereupon the upper right-hand arm and head are brought to the position of the lower arm and head, and consequently demagnetized by the passing of the appropriate plate *g* out of the circuit established by the commutators, while that which was just previously in this position is carried into said circuit and into the position of the upper left-hand arm and head, as shown in the drawings, whereupon an action the like with that just described carries the armature another third of a revolution, and so on as each successive armature-head is demagnetized, while that immediately preceding it is magnetized to act in conjunction with the poles of the magnets C, as described, thereby insuring the continuous rotation of the armature A, or, in other words, of the motor. By reason of the successive makings and breakings of the current through the commutators two of the arms and armature-heads are thus energized to act in conjunction with the duplicate magnets C C, while another of said arms and armature-heads is demagnetized or inert. To change the direction of rotation it is of

course necessary to reverse the character of the current—in other words, to place the negative pole of the source of electric energy in the connection previously occupied by the positive pole thereof, and vice versa. This is done by the switch apparatus shown in Figs. 1 and 2, as follows: Two metallic swinging arms A^4 B^4 (shown in dotted outline at the left of Fig. 1) are connected by a cross-bar C^4 with a lever D^4, by which they may be simultaneously swung in the one direction or the other. They are mounted upon a non-conducting block E^4. The metallic pivots a^4 and b^4 of the arms A^4 B^4 are connected with the positive and negative line-wires C^9 and D^9 of the battery E^9 or other source of electrical energy to transmit currents to and through the arms. Fixed in and passing through the block E^4 are metallic pins a^7, b^7, c^7, and d^7. The pins a^7 d^7 are connected by a wire e^7 with each other, and the pin b^7 is connected with the one wire D^5 of the circuit through the motor. The pins b^7 and c^7 are connected by a wire f^7. The pin d^7 is connected with the other wire C^5 of the circuit-wires of the motor. The upper or swinging ends of the arms A^4 B^4 are so disposed with reference to the ends of the pins a^7 b^7 c^7 d^7 as to come in contact therewith in the relation presently described when brought into due position. Thus when the lever D^4 is in the central position indicated in continuous outline in the drawings the arms A^4 B^4 are not in contact with any of the pins a^7, b^7, c^7, and d^7, and, there being no electrical connection between the battery-wires D^9 C^9 and the circuit-wires of the motor, the circuit through the latter is broken and the motion of the motor is stopped. When the lever is swung to the right to bring the arms A^4 B^4 into the position shown in dotted outline, the arm A^4 into connection with the pin c^7, and the arm B^4 into connection with the pin a^7, electrical connection is established between the battery and the motor, the wire C^5 being in this case the positive and D^5 the negative wire of the motor. When the lever is moved to its limit in the reverse direction, the arms A^4 B^4 are brought away from the ends of the pins a^7 and c^7 and into contact with the ends of the pins b^7 and d^7, thereby changing the direction of the current derived from the battery or other source of electricity and converting the previously positive wire of the motor into a negative and the previously negative into a positive wire in its relations with the motor, thereby reversing the direction of motion of the revoluble armature by reversing what had been its north or positive pole into a south or negative pole, and conversely.

What I claim as my invention is—

1. In an electro-motor the combination with magnets, A, and a revoluble armature, C, having radial arms, A′, of the heads, B′, carried upon the ends of the arms, having bores, a, parallel or substantially so with the axis of motion of the armature and helices coiled upon the arms, and carried or extended through the said bores to promote the magnetization of the heads, and connected with a suitable commutator, substantially as and for the purpose herein set forth.

2. In an electro-motor the combination with magnets A, and a revoluble armature, C, having radial arms, A′, of the heads, B′, carried upon the ends of the arms, having bores, a, slitted as shown at, a', and arranged parallel to the axis of motion of the armature, helices coiled upon the said arms and extended through the said bores to promote the magnetization of the heads and a commutator for making and breaking the current in succession through the helices, substantially as and for the purpose herein set forth.

3. In an electro-motor the combination of the duplicate magnets, C, placed opposite each other, a revoluble armature, A, having radial arms A′, armature heads, B′, carried at the outer ends of said arms, having bores, a, slitted as at, a', commutator plates, g, revoluble with the armature, blocks, h, for insulating said plates, and helices wound upon the arms, continued through the bores and connected to the plates, g, and commutating devices arranged for connecting with the source of electric energy, substantially as and for the purpose herein set forth.

4. In an electro-motor the combination of the duplicate magnets, C, placed opposite each other, the revoluble armature having arms A′, and armature heads, B′, the plates, g, insulated or separated from each other and carried by and insulated from the axial part of the armature, helices carried by the said arms, wires connecting the plates with the respective helices as described, and conducting rollers arranged to bear against the said plates, and spring supports for said rollers, means for insulating the rollers from said supports, and wires for conducting the current to said rollers, all substantially as and for the purpose herein set forth.

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