No. 652,775. Patented July 3, 1900.

D. O. HULL.

ALTERNATING CURRENT REGULATOR.

(Application filed Mar. 1, 1899.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.

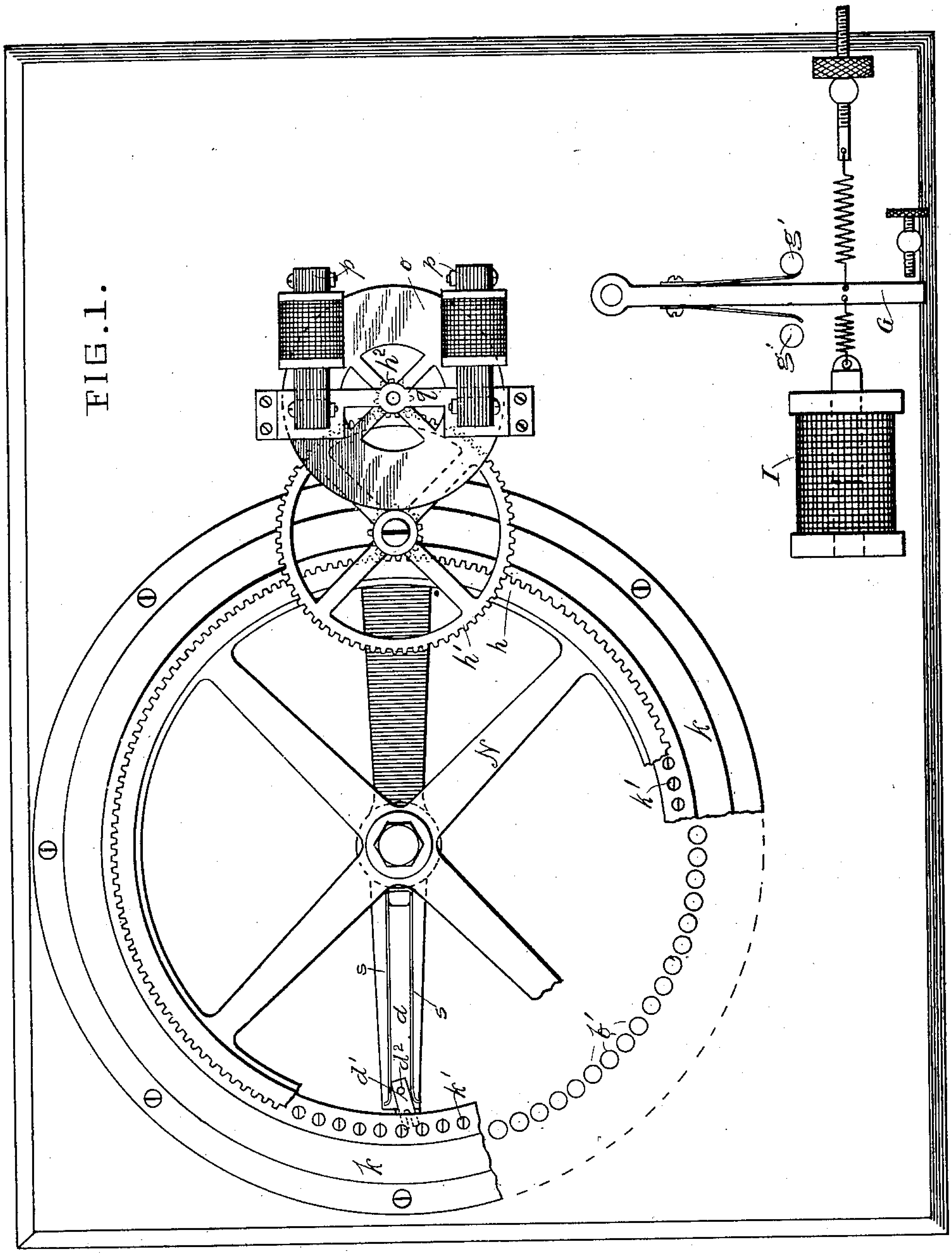

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FIG. 2.

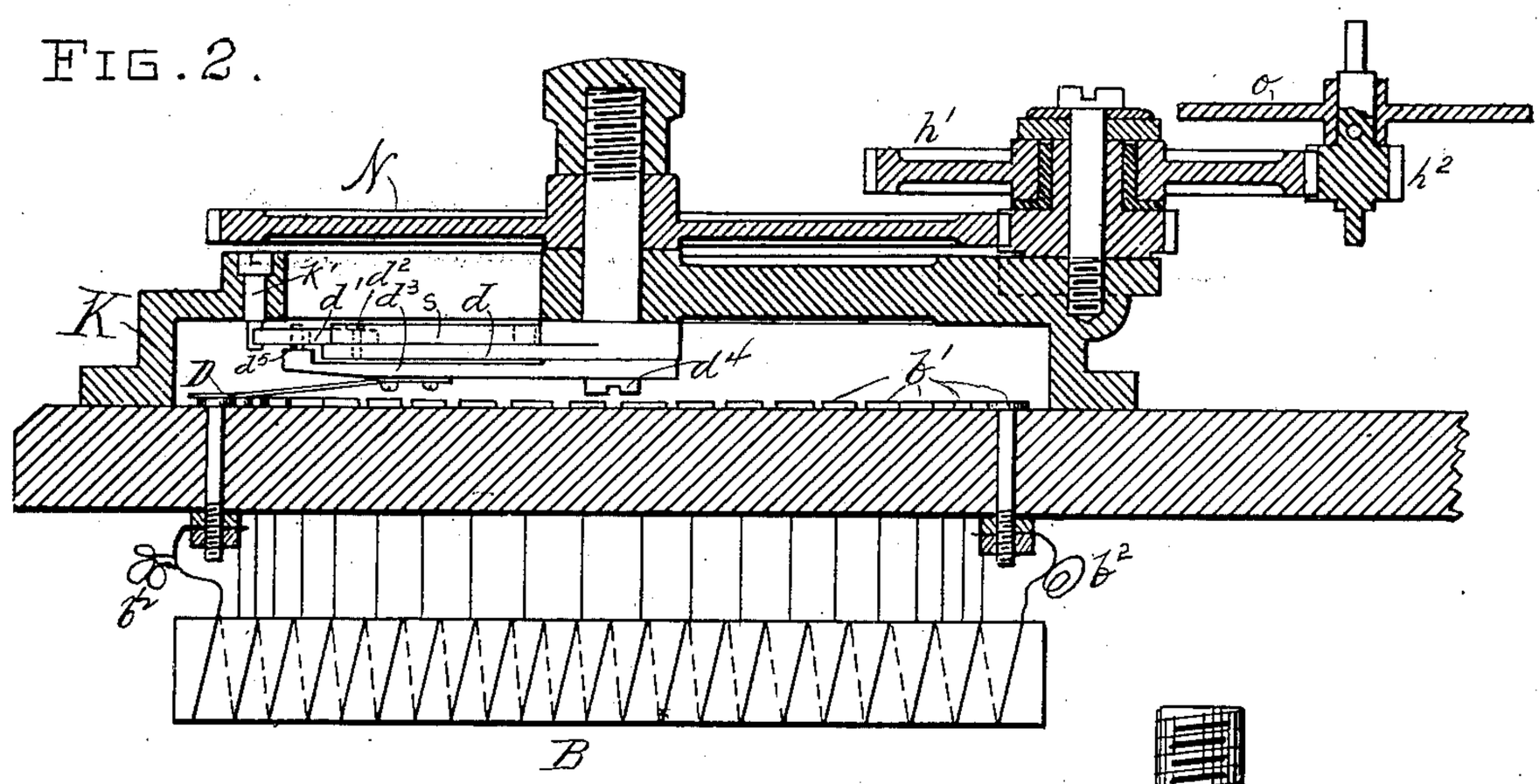

FIG. 3.

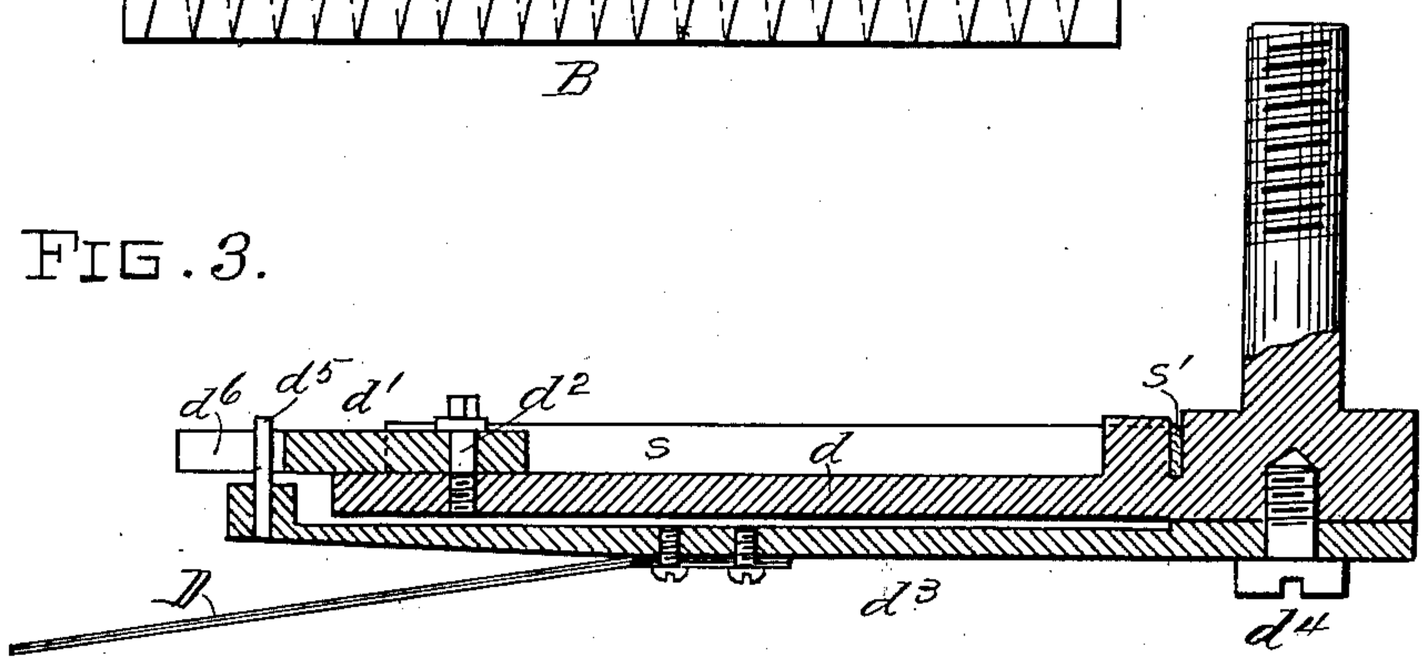

FIG. 4.

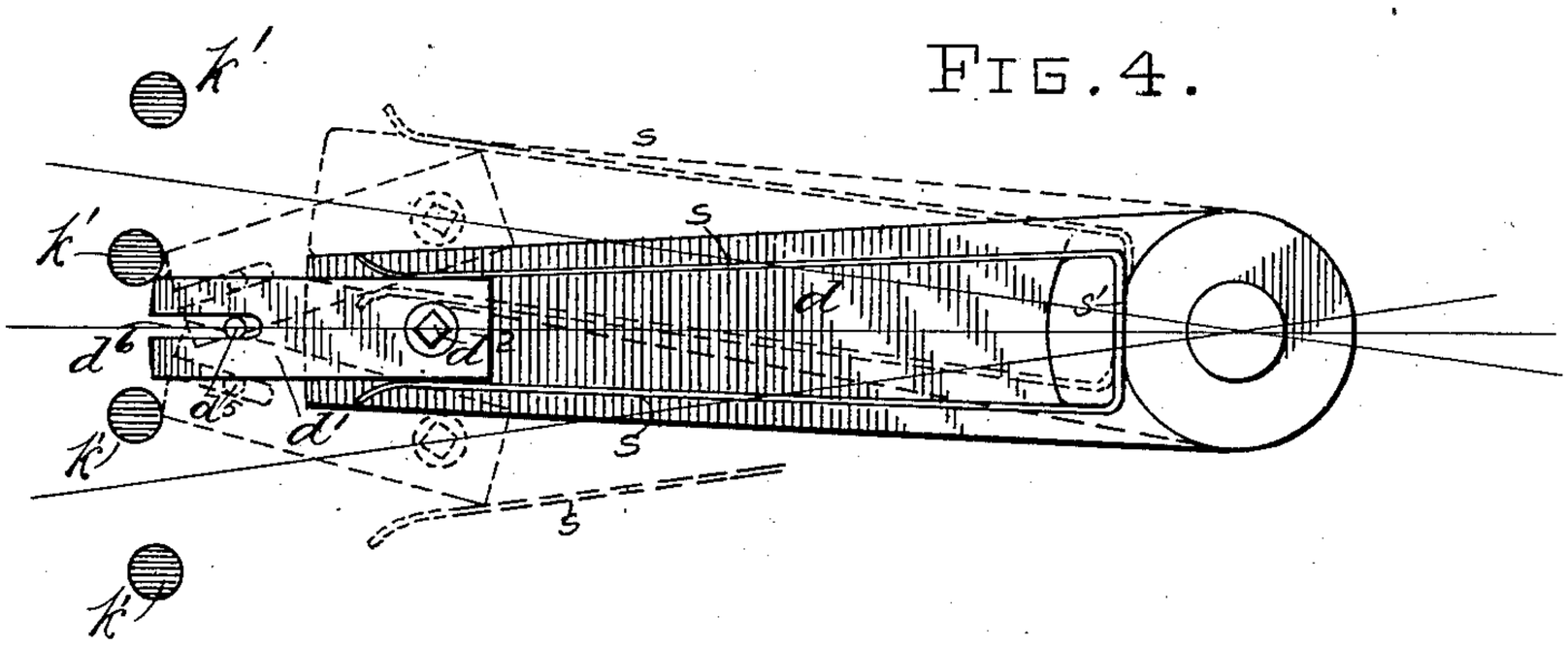

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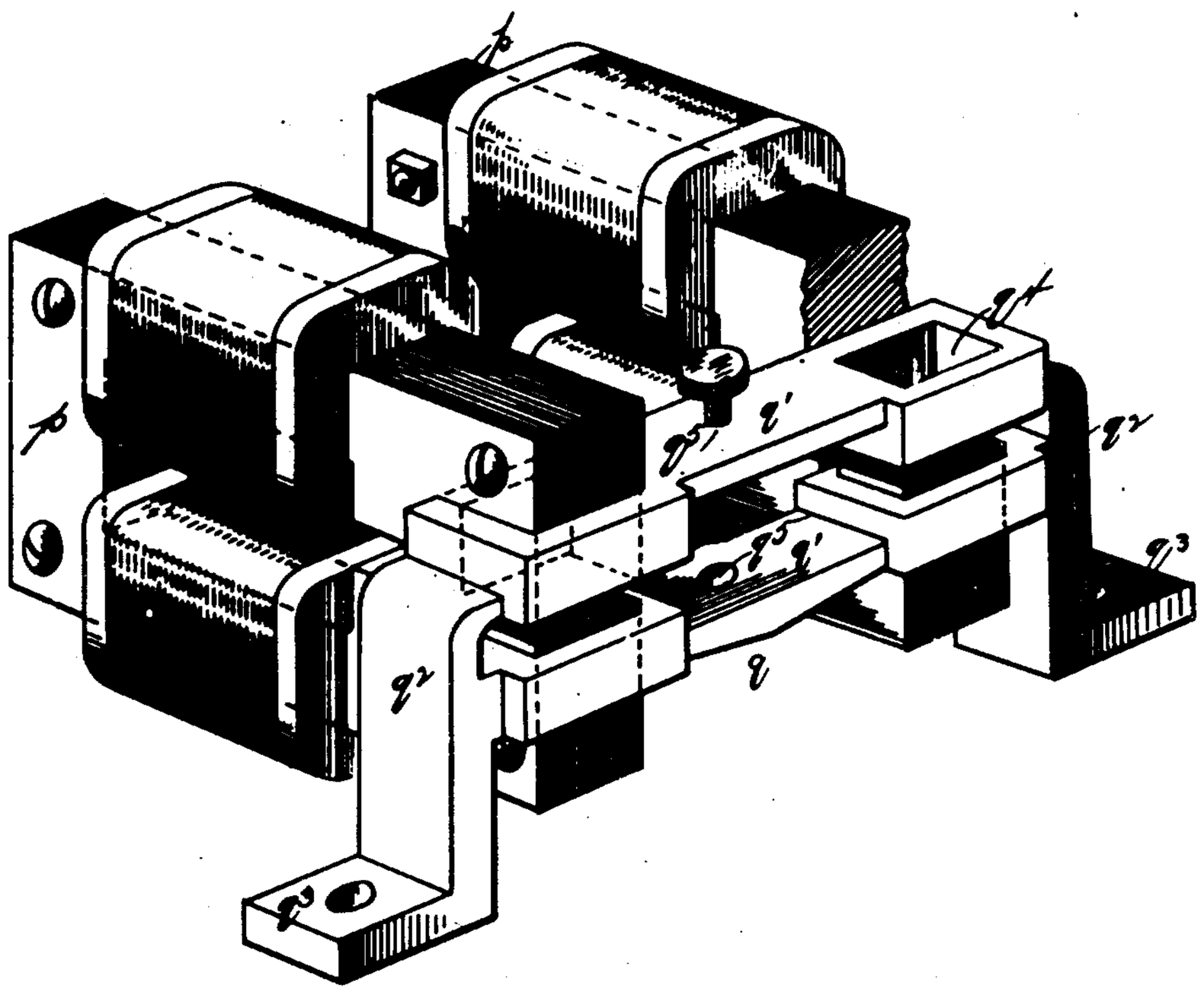
FIG. 5.



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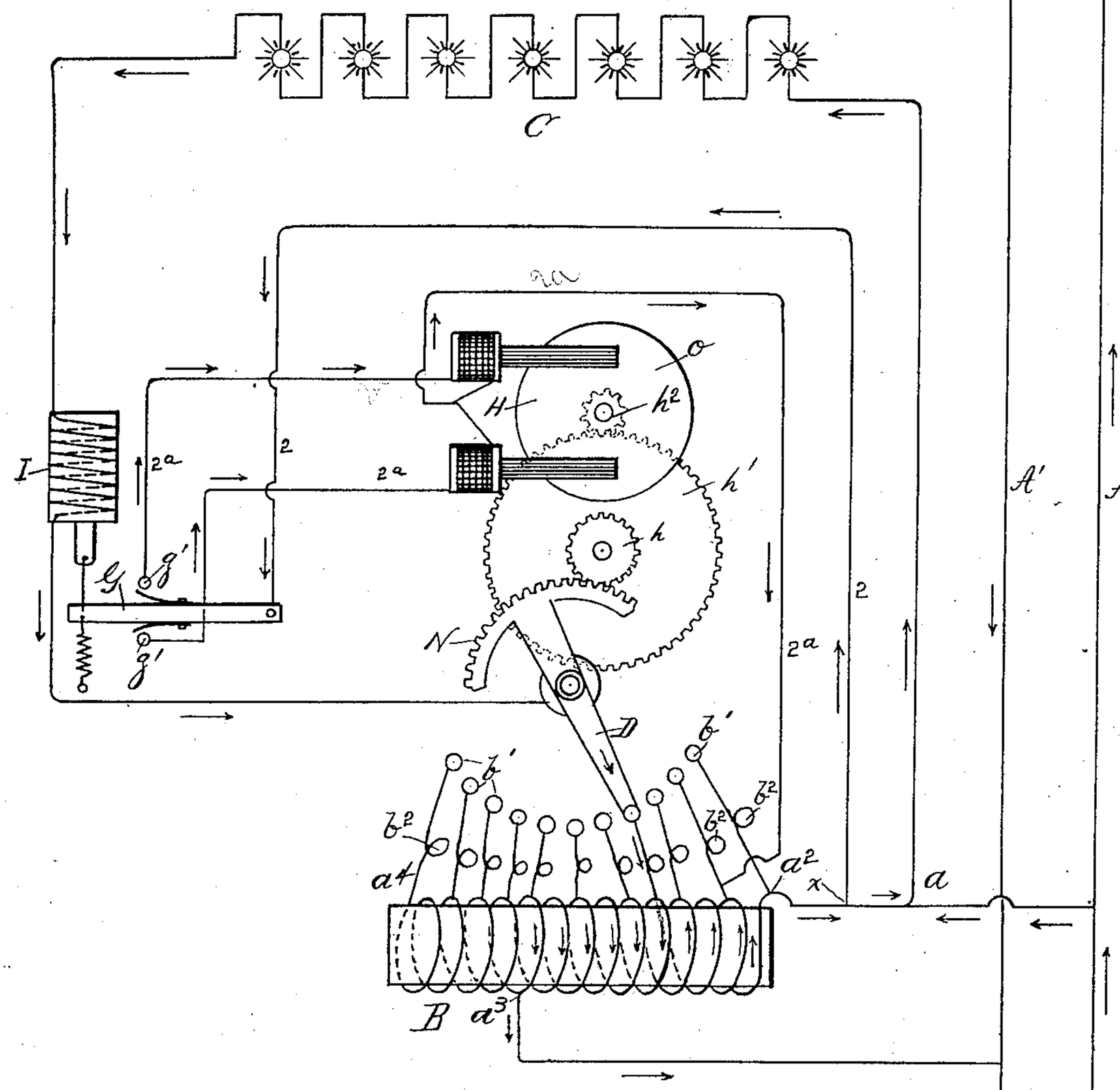
(No Model.) 4 Sheets—Sheet 4.

FIG. 6.



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His Atty.

UNITED STATES PATENT OFFICE.

DANIEL OSCAR HULL, OF PORT CLINTON, OHIO.

ALTERNATING-CURRENT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 652,775, dated July 3, 1900.

Application filed March 1, 1899. Serial No. 707,270. (No model.)

To all whom it may concern:

Be it known that I, DANIEL OSCAR HULL, a citizen of the United States, residing at Port Clinton, Ottawa county, Ohio, have invented certain new and useful Improvements in Alternating-Current Regulators, of which the following is a specification.

My invention relates to an apparatus for controlling the current in circuits fed from alternating-current constant-potential mains; and its object is to automatically maintain any desired current (up to the capacity of the system) in a circuit which is fed from alternating-current constant or approximately constant potential mains, whatever be the number or resistance of the translating devices which may be connected in or cut out of said circuit.

My invention is more particularly designed as an improvement upon the apparatus shown and described in United States Letters Patent granted to me November 2, 1897, No. 593,050.

These improvements relate to the construction of the brush and its actuating mechanism, the autoconverter, and the construction and connections of the induction-motor described in said patent, and also to the simplification of my previous device by the omission of various parts. These results are secured in the manner and by the means hereinafter described, and shown and illustrated in the accompanying drawings, made part hereof, in which—

Figure 1 is a plan view of my regulator with part of the main gear-wheel and ring, hereinafter referred to, broken away to show the contact-pieces, hereinafter referred to; Fig. 2, a central longitudinal sectional view of a portion of the same; Fig. 3, a central longitudinal sectional elevation of the brush, hereinafter referred to; Fig. 4, a top plan view of the same; Fig. 5, a perspective view of the pair of alternating-current motor-magnets, hereinafter referred to, together with their housing and support, one of the magnets being partly broken away to more fully show the form of said housing; and Fig. 6 is a diagrammatic view of a circuit and apparatus embodying my invention.

Like parts are represented throughout the views by like letters and figures of reference.

In the drawings, A A′ represent the two alternating constant-potential mains. B represents an autoconverter which is connected across said mains. The windings of the autoconverter are connected at suitable intervals with contact-plates b'. The circuit which it is desired to control has one terminal permanently connected with one main A, as at a, while the other terminal is connected with the movable brush D, which may be successively moved into contact with the several plates b'.

The translating devices C may be of any desired character and may be adapted to be independently connected in the circuit "in series" or cut out, as desired. It is evident that by the movement of the brush D back and forth over the contact-pieces b' any desired potential difference between the terminals of the circuit to be regulated (up to the capacity of the system) can be obtained.

When the translating devices C (which for illustration in this instance are arc-lights) are located at a distance from the controlling mechanism and are liable to be severally turned on or off at any time, it is desirable to provide means which will act automatically to regulate the potential difference of the terminals and keep the current constant in the circuit notwithstanding the variations in resistance due to turning any number of lights on or off. The automatic movement of the brush D, as shown in the drawings, is effected by an induction-motor, and the direction in which the armature of said motor moves is governed by the switch G, which switch is actuated by the core of the solenoid-magnet I, connected in the circuit to be controlled.

A particularly-effective construction, combination, and arrangement of parts for automatically moving the brush D back and forth upon the small contact-pieces b' and for giving a quick make and break to the brush and contact-pieces is shown in Figs. 1, 2, 3, and 4. The contact-pieces b' are arranged in a circle or the arc of a circle. The brush D is carried on the wheel N, mounted in the center of said arc. The wheel is a gear-wheel, which is connected by a train of gears h h' h^2 with the motor H.

To prevent undue sparking, it is necessary that the change of position of the brush from

one contact-piece to another be made very quickly as compared with the slow movement of the wheel upon which it is supported. To this end the wheel N carries a radial metallic bar d, which at its inner end is rigidly connected with the wheel N and revolves therewith. At the outer extremity of the arm d is a radially-projecting short bar or finger d', pivotally connected, as at d^2, to the arm d. d^3 is another radial arm loosely and revolubly mounted, as at d^4, upon the same axial line as the wheel N and normally parallel with the arm d. The arm d^3 carries the radially-projecting brush D, which rests upon and successively encounters the contact-pieces d'. At the extremity of the arm d^3 and rigidly secured at a right angle thereto is a pin d^5, which projects into and engages a slot d^6 in the outer end of the short pivoted bar or finger d'. A double spring s, secured to the arm d, as at s', clasps the two sides of the bar or finger d' and tends to hold bars d' and d^3 normally in radial alinement, though permitting their lateral swing in both directions upon the pivots d^2 and d^4.

A ring K is fixed outside of the row of contact-pieces b' and is provided with an inwardly-projecting overhanging flange k, from the inner side of which project or depend pins k', which are arranged one above each of the spaces midway between the contact-pieces b'. The outer end of the short pivoted bar d' projects so far that when said bar is in a radial position it enters between two adjacent pins k' k', the brush D being now in contact with that one of the contact-pieces b' which lies between said pins. When the wheel N, with its bar d, is moved in either direction, the obstructing-pin k' causes bar d' to swing upon its pivot d^2 until the end of the bar d', being drawn inward by such movement, may pass said pin k'. It will be seen that during this movement of the arm d and bar d' the brush-carrying arm d^3 has remained practically stationary, being thus held by the pin d^5, projecting into the slot d^6 of the arm d'; but when the wheel N and the arm d have traveled far enough to permit the outer extremity of the bar d' to escape from its contacting pin k' the spring s quickly throws the arm d' forward into radial alinement with the arm d and against the next succeeding stop or pin k', carrying with it the arm d^3, which as it swings on its pivot carries the brush into contact with the next succeeding contact-piece b'. Thus it will be seen that no matter how slowly the wheel N may move in one direction or the other the brush is thrown from one contact to the next with the force and rapidity imparted by the spring s.

The windings of the autoconverter, with which the brush D becomes connected as it is moved to and fro in the arc formed by the row of contact-points b, are sufficient in number to meet the ordinary demands of the circuit to be controlled. These windings are represented in the diagram Fig. 6 as extending from a^2 to a^3. I find it advantageous, however, to continue the windings of the autoconverter beyond the fixed terminal, as from a^3 to a^1, in order to provide a step-up conversion of potential beyond the impressed electromotive force of the constant-potential mains. These "step-up" windings of the autoconverter are provided at proper intervals with contact-points b, which are brought into and out of circuit in the same manner as are the windings of the remainder of the converter. It is advantageous to provide a suitable amount of resistance in the wires connecting the windings of the autoconverter with the contact-pieces, as at b^2, Fig. 6.

In a normally-open branch circuit $2\,2^a$, connected with the autoconverter, as shown, is a switch G, controlled by solenoid I in the main circuit. In the circuit $2\,2^a$ is an alternating-current motor H, connected by train of gears h h' h^2 with the wheel N, which carries and controls brush D. This motor consists of the usual revoluble copper or aluminium disk o, mounted between the poles of a pair of magnets p p, the poles of one of said magnets being disposed at one side of the disk, the other magnet's poles being disposed at the opposite side of the disk. (See Figs. 1, 5, and 6.) The magnets and disk are compactly and simply mounted and securely retained in their proper relative positions by the use of a housing-piece q, composed of brass or other suitable non-magnetic metal. The housing-piece may be described as two flat parallel bars q' q', the pair being connected at each end by a leg q^2, each leg having a foot q^3, by which the housing may be secured to a suitable base. Each of the parallel bars q' near each end has an opening q^4 therethrough to receive a part of the ends of the inwardly-turned opposing laminated pole-pieces or cores of the magnets p p. The disk o is journaled between and supported by the two flat parallel bars q' midway of their length, as at q^5. It will be seen that the two magnets are rigidly secured side by side and that the disk o is mounted between them and between their pole-pieces by the use of the single piece or housing q, herein described, which housing also serves as short-circuited rings around the pole extremities.

When by a change in the load C the strength of the solenoid I is increased or diminished, the switch G is thrown into contact with one or the other of contact-pieces g', thus closing the branch circuit $2\,2^a$. From each of the contact-pieces g' leads a separate wire to one of the magnets p, which magnets are connected to the line 2^a. If by the action of the solenoid and the switch one magnet is thrown into circuit $2\,2^a$, the disk o will be set into corresponding motion. If the other magnet be thrown into circuit by the opposite action of the solenoid and switch, the disk will be caused to rotate in the opposite direction, in

either case imparting motion to the brush, by which the proper potential between the terminals is maintained.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an alternating-current regulator, a series of contact-pieces, pins or stops alternating with said contact-pieces, an arm connected with the driving mechanism of the regulator, a bar or finger pivoted to the outer extremity of said arm and projecting between said pins or stops, a spring to hold the arm and finger normally in alinement, a movable brush arranged to successively contact with said contact-pieces, and a sliding connection between said brush and said bar or finger.

2. In a regulator for alternating currents, a pair of mains, an autoconverter connected across said mains, a series of contact-pieces connected with the windings of said converter, a movable brush in the circuit to be controlled adapted to contact with either of said contact-pieces, a solenoid in said circuit, a normally-open branch circuit 2 2^a, connected with said autoconverter, a reversible induction-motor in said branch circuit, driving connections intermediate the motor and the brush, and in said branch circuit a switch controlled by said solenoid.

3. In a regulator for alternating currents, an autoconverter in the circuit to be controlled, a movable brush in said circuit operatively connected with the converter, a branch circuit, a two-point switch in said branch circuit controlled by the main circuit, an induction-motor in said branch circuit adapted to actuate the brush, and two magnets for said motor in said branch circuit at opposite sides of its disk, one of said magnets being connected with one of the contacts of said switch, the other of said magnets being connected with the other contact of said switch.

4. In an alternating-current regulator, in combination with an autoconverter and a movable brush in the circuit to be controlled, an induction-motor operatively connected with said brush, said motor comprising a housing having a narrow flat opening therethrough, a disk journaled in said housing centrally of said opening, and a pair of electromagnets having the opposing extremities of their poles secured in said housing on opposite sides of said opening and embracing opposite margins of said disk, said housing being adapted to serve as short-circuited rings around the extremities of the magnets, substantially as shown and described.

DANIEL OSCAR HULL.

In presence of—
GEO. A. TRUE,
CHAS. F. JOHNSON.