(No Model.) 3 Sheets—Sheet 1.

G. J. SCOTT.

ELECTRO DYNAMIC MACHINE.

No. 454,882. Patented June 30, 1891.

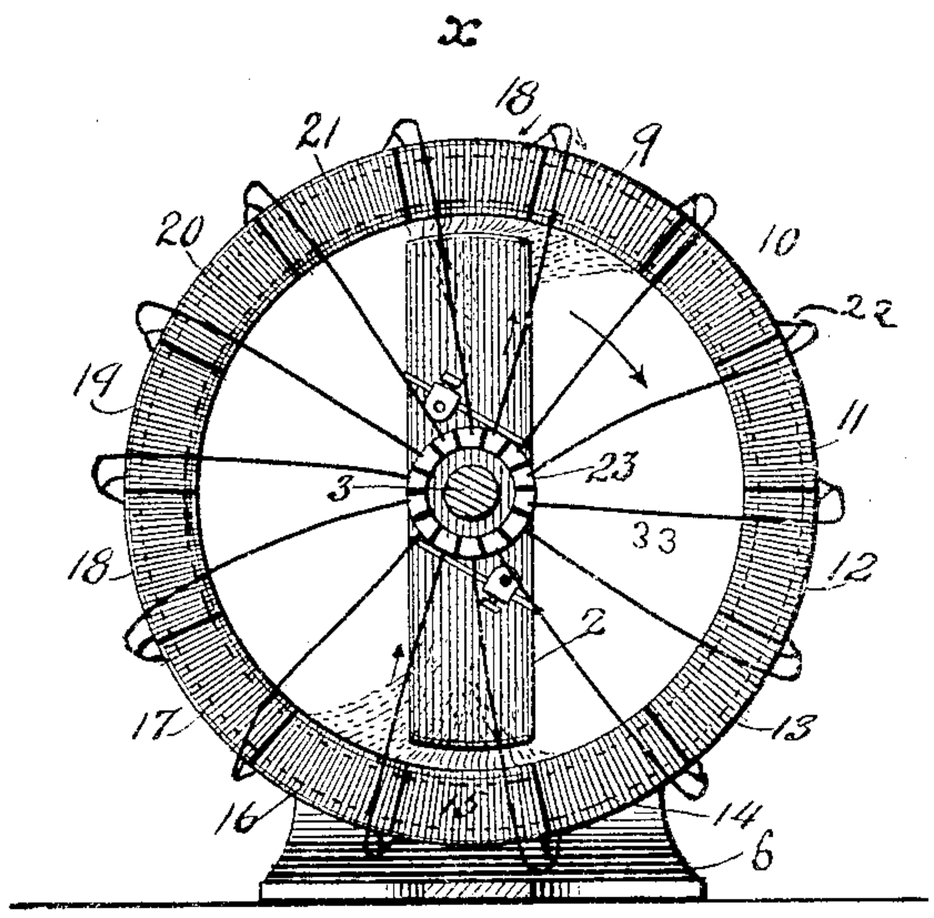


Fig. 1.

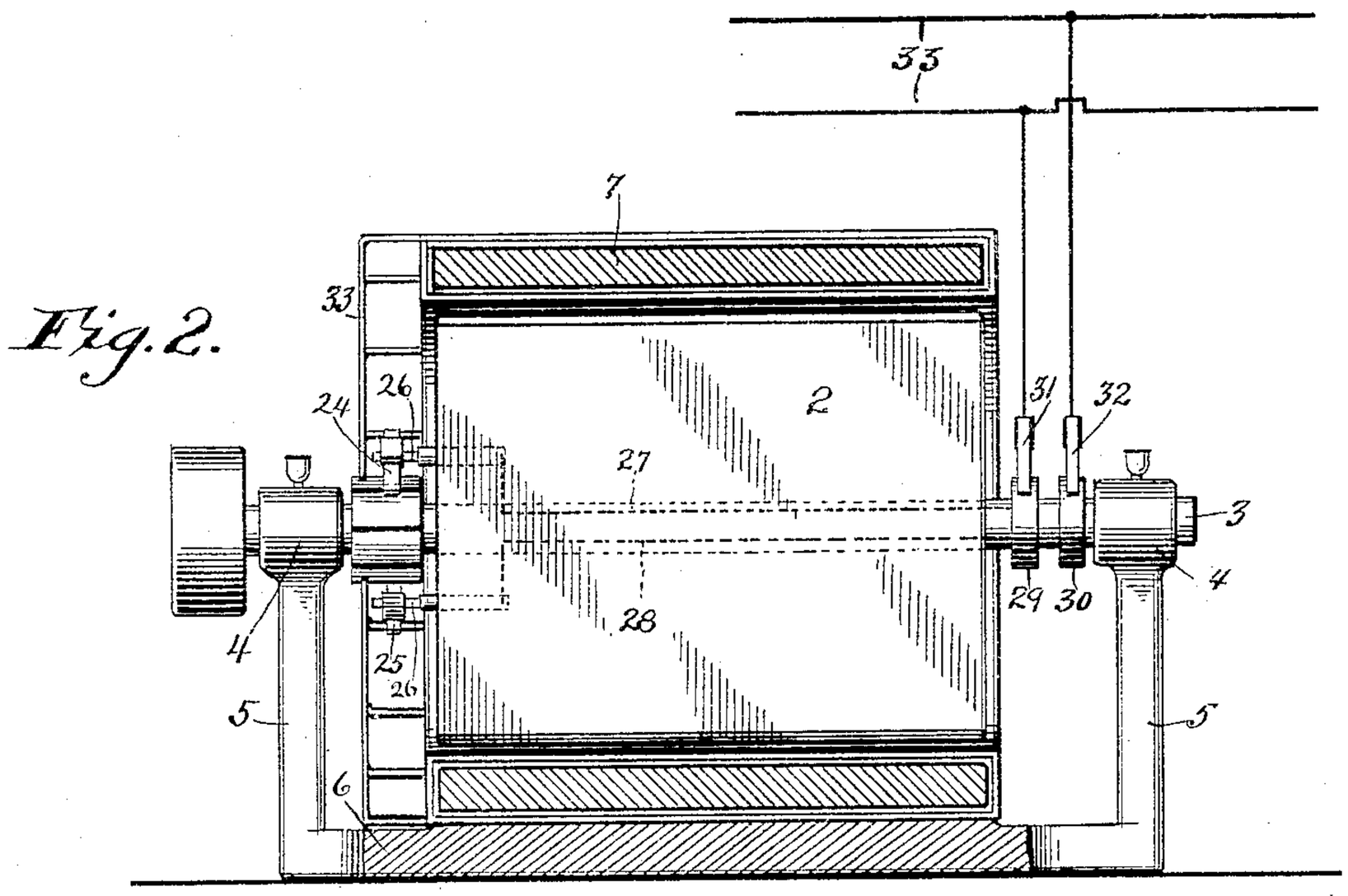


Fig. 2.

Witnesses:
C. E. Van Dorn
C. Hawley

Inventor.
Gordon J. Scott.
By Paul & Sumner Atty's.

(No Model.) 3 Sheets—Sheet 2.

G. J. SCOTT.

ELECTRO DYNAMIC MACHINE.

No. 454,882. Patented June 30, 1891.

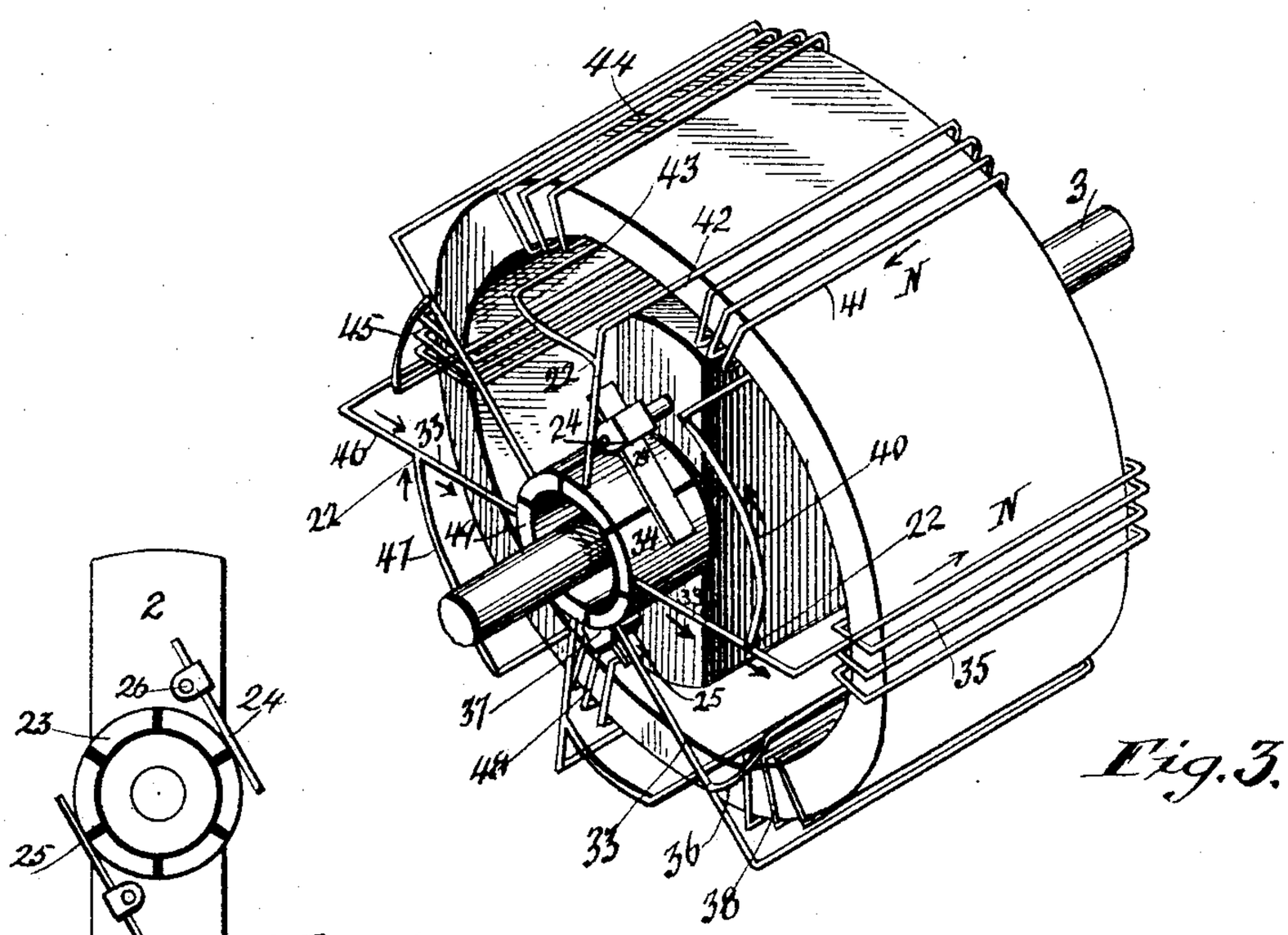


Fig. 3.

Fig. 4

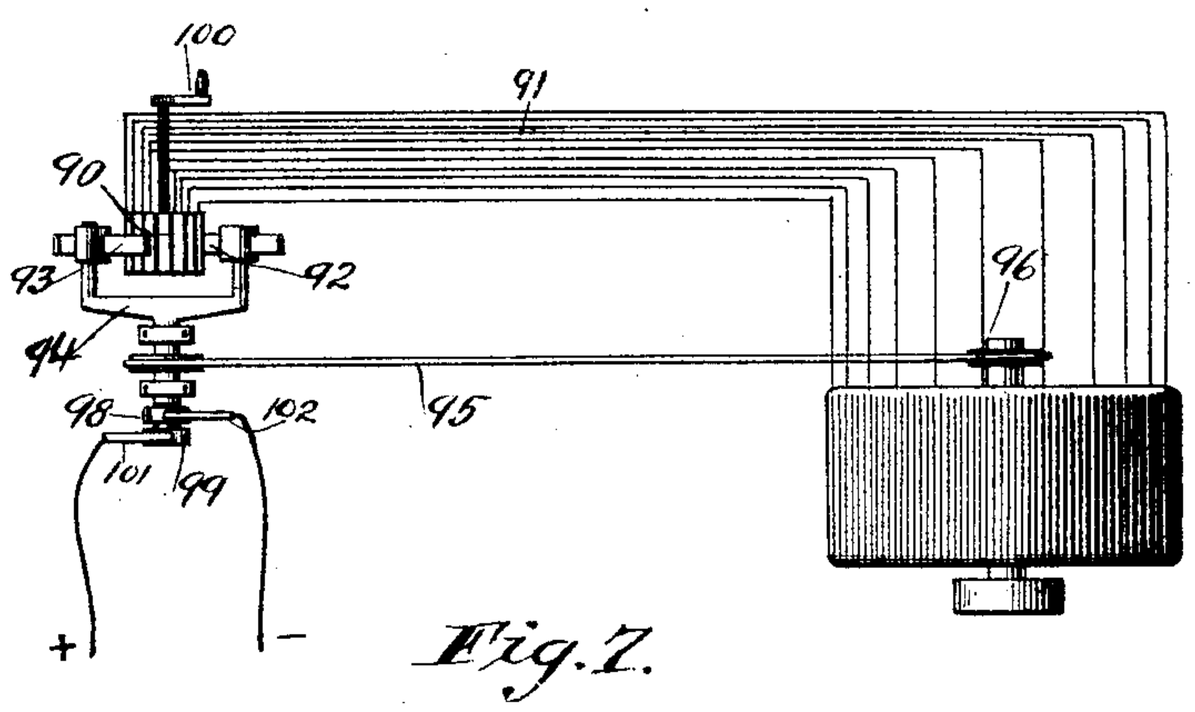


Fig. 7.

Witnesses:
C. E. Van Dorn,
C. H. Hawley

Inventor:
Gordon J. Scott.
By Paul & Sumner Attys.

(No Model.) 3 Sheets—Sheet 3.

G. J. SCOTT.

ELECTRO DYNAMIC MACHINE.

No. 454,882. Patented June 30, 1891.

Fig. 6.

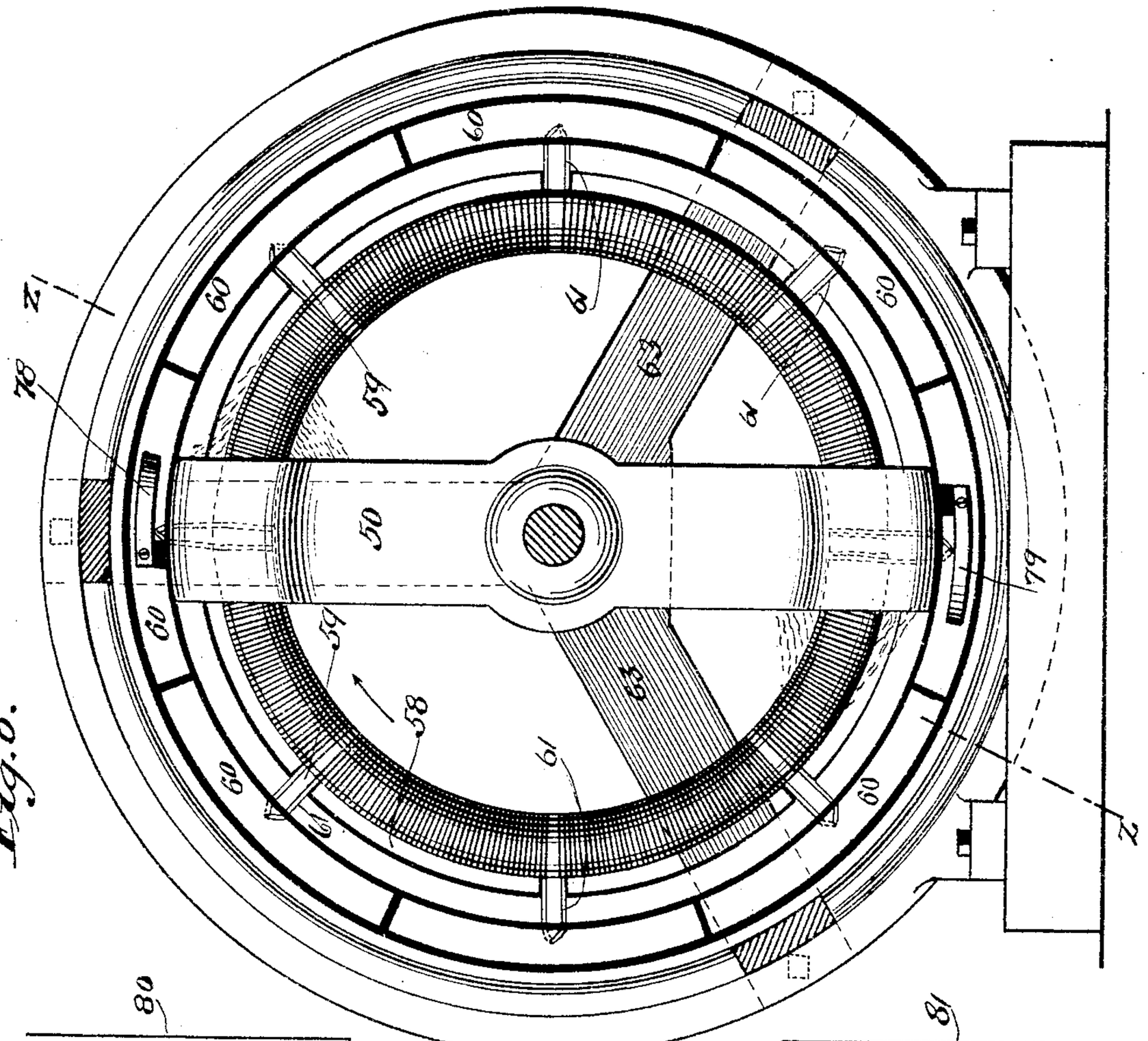
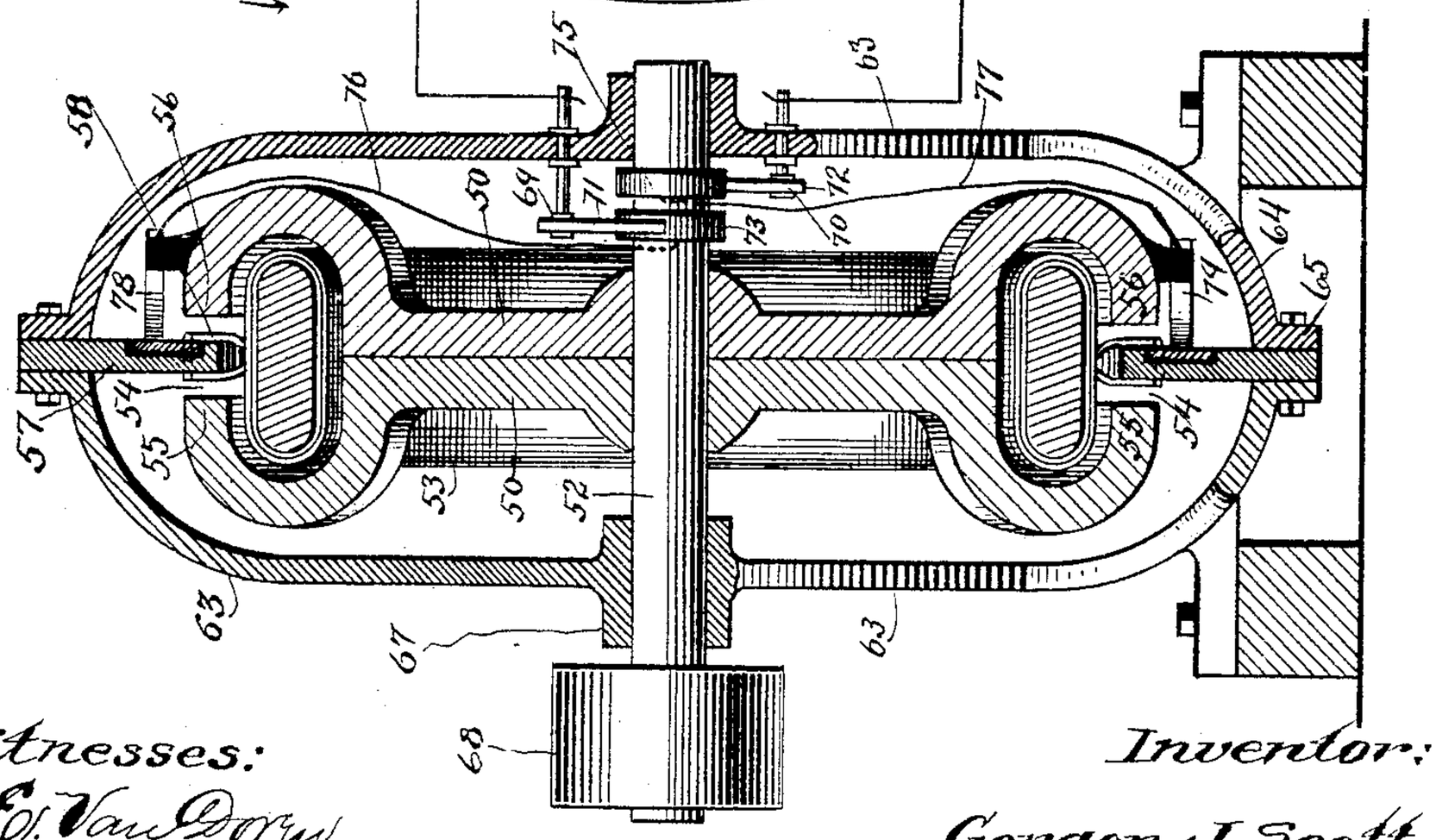


Fig. 5.



Witnesses:
C. E. Van Dorn.
O. Hawley

Inventor:
Gordon J. Scott.
By Paul & Sturtevant Attys

UNITED STATES PATENT OFFICE.

GORDON J. SCOTT, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF ONE-HALF TO CALVIN G. GOODRICH, OF SAME PLACE.

ELECTRO-DYNAMIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 454,882, dated June 30, 1891.

Application filed January 2, 1891. Serial No. 376,504. (No model.)

To all whom it may concern:

Be it known that I, GORDON J. SCOTT, of Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain Improvements in Electro-Dynamic Machines, of which the following is a specification.

My invention relates to electric motors which are adapted to work effectively on either a constant-potential or a constant-current circuit or an alternating-current circuit, and which without alteration may be employed as a continuous-current generator, or which with slight modification may be employed as an alternating-current generator.

The object of the invention is principally to provide an efficient continuous or alternating current electro-dynamic machine of an extremely simple construction, which may be readily regulated to run at a very low speed or at a very high speed, and to provide means whereby the motor may be controlled from a point considerably removed therefrom.

My invention consists in an electric machine having its stationary part or field-magnet made up of an annular ring provided with sectional windings arranged in series about the same, the strands extending between the several sections being connected with the corresponding segments of a suitable stationary commutator, and a simple block, bar, or plate of soft iron arranged on a shaft concentric with the axis of the annular iron ring, brushes arranged on said block-armature and adapted to make contact with the segments of said commutator, and means whereby said brushes are connected with the branches of an electric working-circuit, whereby, as there are no windings upon the armature, the signs of the magnetic poles may be disregarded, and hence any kind of current used in the energizing of the field, and whereby current is introduced into the field successively at points just in advance of the armature, thereby at all times causing the diametrically-opposite points of greatest magnetic intensity in the field to move or rotate about the ring in advance of the armature, and thereby creating a constant pull thereon to rotate the same. The annular ring is of uniform cross-section of the Gramme type, though a Pacinotti ring may be employed; but the variable air-spaces in this ring form an objection to its use, and I shall confine myself in the description to the Gramme-ring field-magnet.

My invention consists, further, in means whereby the motor may be controlled from a distance by the use of an independent commutator or collector-brushes detached from the work of the motor.

Further, the invention consists in various constructions and combinations hereinafter described, and particularly pointed out in the claims.

My invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is an end elevation of a machine embodying my invention. Fig. 2 is a longitudinal section taken on the line *x x* of Fig. 1. Fig. 3 is an isomtric diagrammatic representation of the field-magnet ring and windings, commutator, armature, and commutator-brushes. Fig. 4 is a view showing the position of the brushes on the commutator. Fig. 5 is a longitudinal section showing a modified form of armature and field-magnet support. Fig. 6 is an end view thereof. Fig. 7 shows means for controlling the motor from a point removed therefrom.

As shown in the first four figures of the drawings, the armature of the motor consists in a flat thin block or bar 2 of soft iron, either made in one piece or of insulated laminations and secured on the shaft 3, supported in the bearings 4, provided at the upper ends of the arms 5, extending from the non-magnetic base 6. Arranged upon this base 6 and supported concentrically with the shaft 3 is a soft-iron annular ring 7 of a uniform cross-section equal to half that of the armature-block and having sectional windings arranged in series, one with the other, after the usual Gramme type, the separate windings 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, and 21 being connected together by the short strands or loops 22. As usual, all of the windings and their connecting-loops consist practically of one continuous wire having its ends con-

nected. The commutator 23 is preferably provided with segments equal in number to the sections of the field, though it is obvious that the number of these segments may be increased so long as an equal ratio is maintained with the number of sections on the magnet-ring. This commutator is arranged concentrically about the shaft 3, but entirely independent thereof, being supported either upon the ring or upon the bearing 4. Brushes 24 and 25 of a common form are arranged upon pins 26, extending from the end of the armature, and are connected by wires 27 and 28 (shown in dotted lines) with the contact-rings 29 and 30, insularly provided on the shaft 3. Terminal brushes 31 and 32, connected with the two sides of the working-circuit 33, are provided on some stationary part of the machine and are adapted to make contact with the rings 29 and 30. As shown, strands 33 extend from the segments of the commutator to the points 22 between the windings or bobbins 8 9 10 11, &c., on the field-magnet ring 7, whereby current being introduced into a commutator-segment is divided and passed through an equal number of sections on the ring, the divided currents uniting and passing out of the machine through the commutator-segment diametrically opposite that on which the current enters. The brushes are arranged for convenience to push forward around the periphery of the commutator, and are given such a lead as to cause the magnetic poles in this field to move around the ring in advance of the armature as the same is revolved by attraction of said poles.

In Fig. 3 a number of the bobbins have been removed to more clearly show the windings, all of those shown being connected in series in the usual manner. Suppose that a current of electricity enters the machine through the brush 24, it would then pass through the segment 34, from which the positive current might be traced through the strand 33, leading to the bobbin 35, where the wire passes over the top and thence around the ring, passing out through the leg 36, connecting to the strand 33, leading to the commutator-segment 37 and to the bobbin 38. As shown, the strand 33 is divided at 22, one leg leading therefrom to the coil 35, while the other leg 40 leads to the coil 41, passing across the inside of the ring, and thence over the top of the same and leading out through the leg 42 to the leg 43, connecting with the bobbin 44. From thence the path of the current may be traced to the winding 45, and thence by the leg 46 to the connection 22 on the strand 33 between that leg and the leg 47, extending from the coil 48, into which current flows through the coil 38 on its way from the coil 35. From the connection between the legs 46 and 47 current flows into the commutator-segment 49, from which it is taken out by the brush 25. Thus it will be seen that the current entering on the segment 34 of the commutator divides between the coils 35 and 41 and flows through the several coils on the two halves of the iron field-magnet ring, the current entering again on the opposite side of said ring and passing into the commutator-segment 49 opposite the segment 34. The positive current in dividing passes equally, the resistance of the sides being equal through the coil 35, and the coil 41 being switched through the first just at the time when the armature arrives beneath the coil 41. At the same time the polarities of the field are also moved ahead a step to pass current through the coil 35, and hence the armature will be turned on its axis and drawn toward the coils 35 and 45, the armature tending to establish itself in the most direct passage of the lines of force. Just at the instant that the armature arrives in such a position, or at a time when equilibrium would ensue if the brushes were not shifted, the brushes are carried forward onto the next pair of commutator-segments, thereby shifting the current through the coils next in advance and again throwing the armature out of equilibrium.

By multiplying the number of bobbins on the field-magnet ring it will be seen that a large number of strong impulses or pulls may be exerted on the armature during each revolution thereof, and thereby a strong and continuous torque maintained between the field and the revolving armature. Further, it will be clearly seen that by adjusting the brushes ahead on the commutator a greater lead may be maintained, and as a consequence a much higher speed attained in the armature. By moving the brushes back the speed of the armature may be decreased or the direction of revolution reversed.

In Figs. 5 and 6 I have shown a motor differing from the motor shown in the preceding figures in the construction of the armature and manner of supporting the field-magnets. The armature is divided into two parts 50 50, keyed to the shaft 52 and having their ends formed around the Gramme ring 53. These ends practically conform to the shape of the ring and inclose the same, with the exception of a gap 54 between the ends 55 and 56, left for the brass spider 57, secured on the iron ring and forming a support for the field-magnet ring. As shown, gaps 58 are left between the legs 59 of the brass spider for the admission of the wire of the bobbins between the same on the outside of the field-magnet rings. The commutator is arranged upon the face or side of the spider 57, being insulated therefrom. The loops extending from one bobbin to the next pass through and make electrical connection with the various segments 60 of the commutator. Thus instead of running strands, as 33 in Fig. 1, from the said loops 61 or 22 the commutator-segment itself forms the strands. Thus it will be seen that current entering on one commutator-segment divides and flows down on opposite sides of the ring and through the loops between the bob-

bins, and uniting again at the commutator-segment opposite the one on which the current entered and passing out to line. The arms 63 extend from the spider 57 to a ring 64, formed integrally with the arms and provided with feet 65, bolted to the spider. These arms support the bearings 67 for the shaft 52, and on that side opposite the driving-pulley 68 support the brush-holders 69 and 70, from which brushes 71 and 72 extend and make contact with contact-rings 73 and 75, provided on the shaft, but insulated from the same and from each other. Insulated conductors 76 and 77 extend along the sides of the armature between the brushes thereon and the insulated brass rings 73 and 75, provided on the shaft. For clearness these conductors are shown detached from the side of the armature. Say that current enters the machine over the branch 80, from which its path may be traced through the stationary brush 71 to the shaft-contact ring 73, and thence by the conductor 76 to the brush 78, making contact with the upper segment of the commutator. From thence the current divides and passes down through the opposite sides of the field-magnet-ring windings, meeting again at the lower segment, and being taken up therefrom by the brush 79 and conducted out by way of the ring 75 and brush 72 to the branch 81 of the working-circuit. As this circuit is established, it will be seen that the line of greatest magnetic intensity in the field will be established in the approximate position of the line *z z* on Fig. 6, thus creating a lead and causing the armature 50 to rotate forward. As the brushes are carried forward by the moving armature they make contact with the next commutator-segments, whereupon the lines of force are shifted forward to give a new impulse to the armature. The position of the brushes on the commutator governs the magnetic lead, which may be adjusted forward or back as it is desired to start, stop, or reverse the armature or alter its speed.

In Fig. 7 I have shown in diagram the manner of arranging a commutator and revolving brushes when it is desired to control the action of the motor from a distance—as, for instance, the motor, being back under the floor of the street-car, is to be controlled by the driver on the front platform. In such a case the motor, consisting of a simple block-armature and field-magnet ring with suitable bearings, would be inclosed in a dust and water tight shell or box, the shaft of the armature extending through the same and provided with a necessary driving-pulley. On the platform of the car, within reach of the driver, I provide a normally-stationary commutator adapted to be turned with respect to the brushes by suitable means, as the crank-arm 100. Insulated conductors 91 pass from between the several field-magnet windings of the motor to corresponding commutator-segments on the commutator 90. Brushes 92 and 93 bear on the surface of the commutator, being supported by a revolving brush-holder 94 propelled by a belt 95, passing over a pulley on the brush-holder shaft and from the pulley 96 on the armature-shaft of the motor. Insulated rings 98 and 99 are provided on the brush-holder shaft, conductors leading therefrom to the individual brush-holders 92 and 93. As current enters over the brush 101, bearing on the ring 99, it passes to the commutator-segment upon which the brush bears, from thence passing through the windings of the motor and out through the opposite commutator-segment and the brush 102. Current being turned on, the driver would turn the commutator slightly to create a lead in the magnetic field of the motor, whereupon the armature will be caused to rotate, and in turn operate the brush-holder, which, moving ahead of the armature, makes such connections as to always keep the magnetic poles in the motor-field ahead of the armature.

It is obvious that by making the motor-shell water-tight and providing suitable stuffing-boxes about the armature-shaft the motor could in this way be operated beneath the surface of a body of water. In such a case, or under other circumstances, a flexible mandrel-shaft might be employed in place of the belts for communicating the movement of the armature-shaft to the brush-holders.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, in an electro-dynamic machine, of an annular iron ring field-magnet having windings arranged in diametrically-opposite pairs, with a flat bar or block of soft iron forming an armature adapted to revolve within said ring, a commutator provided in connection with the windings of said field-magnet ring, contact devices carried by said armature and adapted to make contact with said commutator, and connections passing from said brushes to revolving contact devices adapted to make contact with stationary brushes or contact-rings, the branches of the working-circuit being connected with said brushes or rings, substantially as described.

2. The combination, in an electro-dynamic device, of an iron annular ring field-magnet and windings of the Gramme pattern, with an iron armature secured upon a suitable shaft coincident with the axis of the ring, said armature adapted to assume a diametric position between the magnetic poles of the field-magnet ring, the ends of said armature inclosing the said ring, and means whereby current is introduced in the said field-windings to establish the polarities thereof in advance of said armature, substantially as described.

3. The combination, in an electro-dynamic machine, of an annular iron ring provided with sectional field-windings with a commutator arranged about the said ring, the connection between the field-magnet sections being extended through the segments of said

commutator, a block-armature secured upon a support concentric with said ring, the ends of said armature substantially inclosing said field-magnet ring and its windings, contact devices arranged on opposite ends of said armature and adapted to make contact with said commutator-segments, and means for connecting opposite branches of the electric circuit with said brushes, substantially as described.

4. The combination, in an electric motor, of the field-magnet ring provided with sectional windings, with a commutator arranged in connection therewith, the armature composed of pieces 50, having their ends inclosing said ring, sufficient space being left between the adjacent ends of said parts for said commutator and a support for said ring, brushes provided on said armature and adapted to make contact with the segments of said commutator, the shaft 52, supported in suitable bearings, insulated rings provided thereon, said brushes being electrically connected with said rings, and stationary brushes adapted to bear on said rings and connected with the terminals of the electric circuit, substantially as described.

5. The combination, with the Gramme ring having windings, of the armature composed of parts 50, having the ends substantially inclosing said ring, and the supporting-ring 57, arranged in a suitable frame, substantially as described.

In testimony whereof I have hereunto set my hand this 26th day of December, 1890.

GORDON J. SCOTT.

In presence of—
C. G. HAWLEY,
C. E. VAN DOREN.