(No Model.) 2 Sheets—Sheet 1.

C. J. VAN DEPOELE.

ELECTRIC MOTOR.

No. 394,035. Patented Dec. 4, 1888.

Fig. 1.

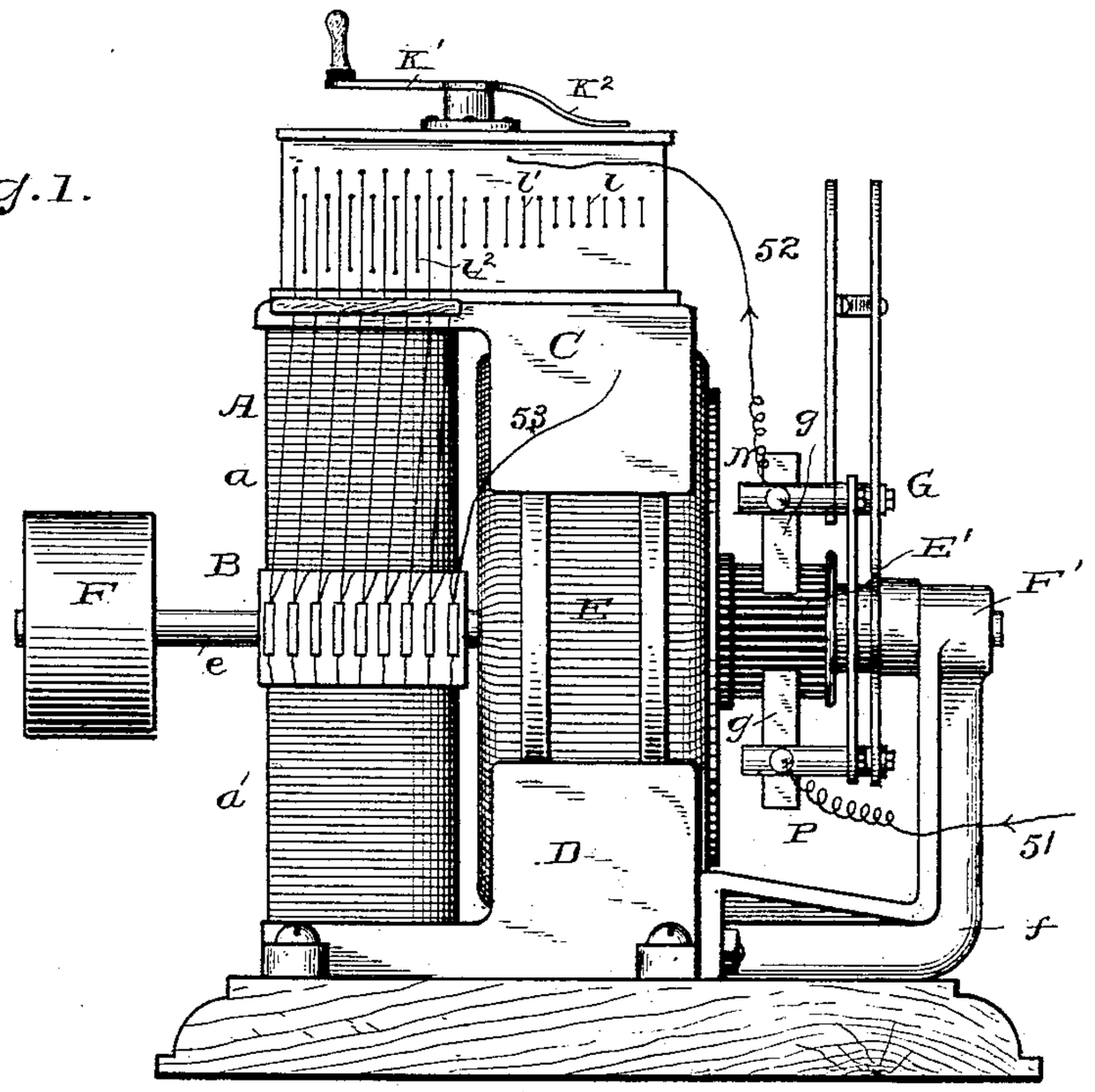


Fig. 2.

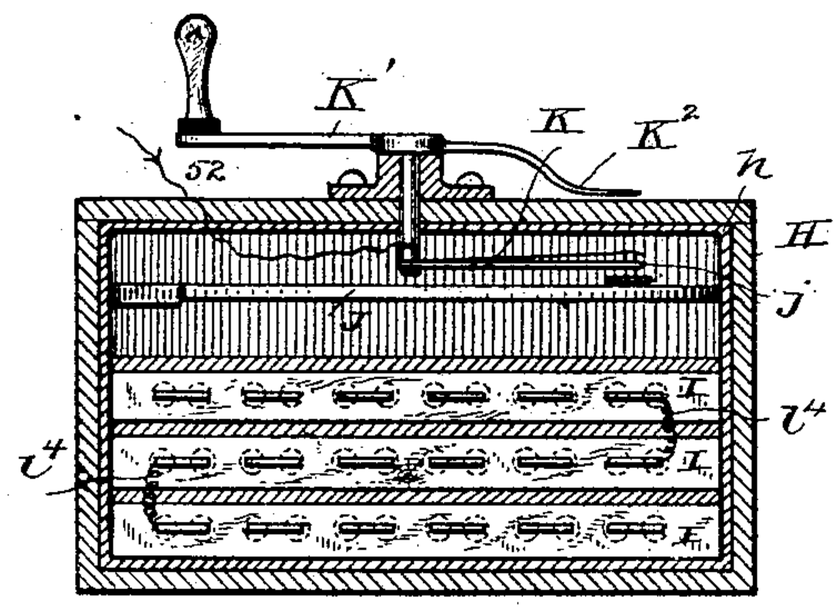
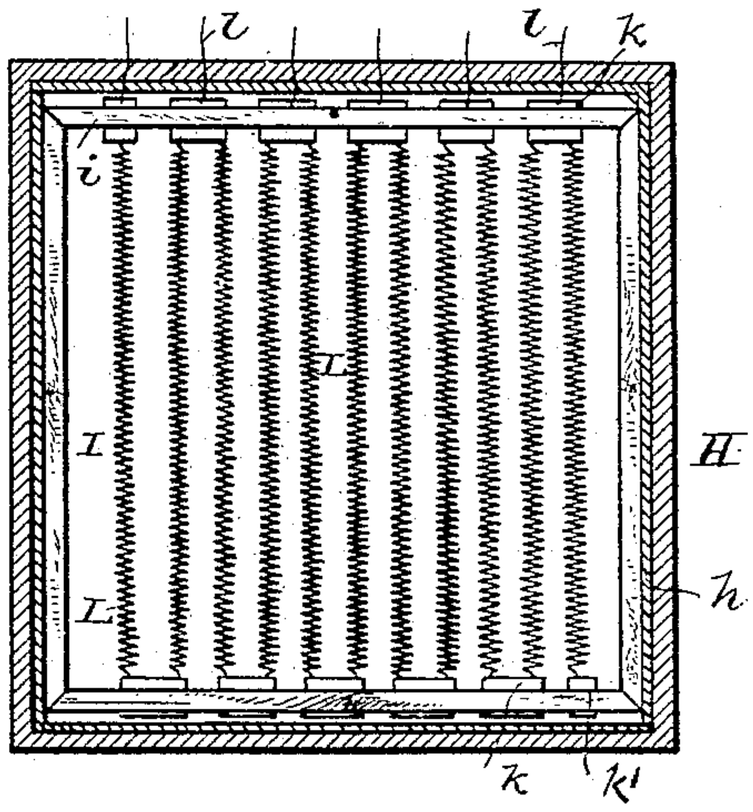


Fig. 3.



Witnesses.

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Stephen James.

Inventor.

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Attorney.

(No Model.) 2 Sheets—Sheet 2.

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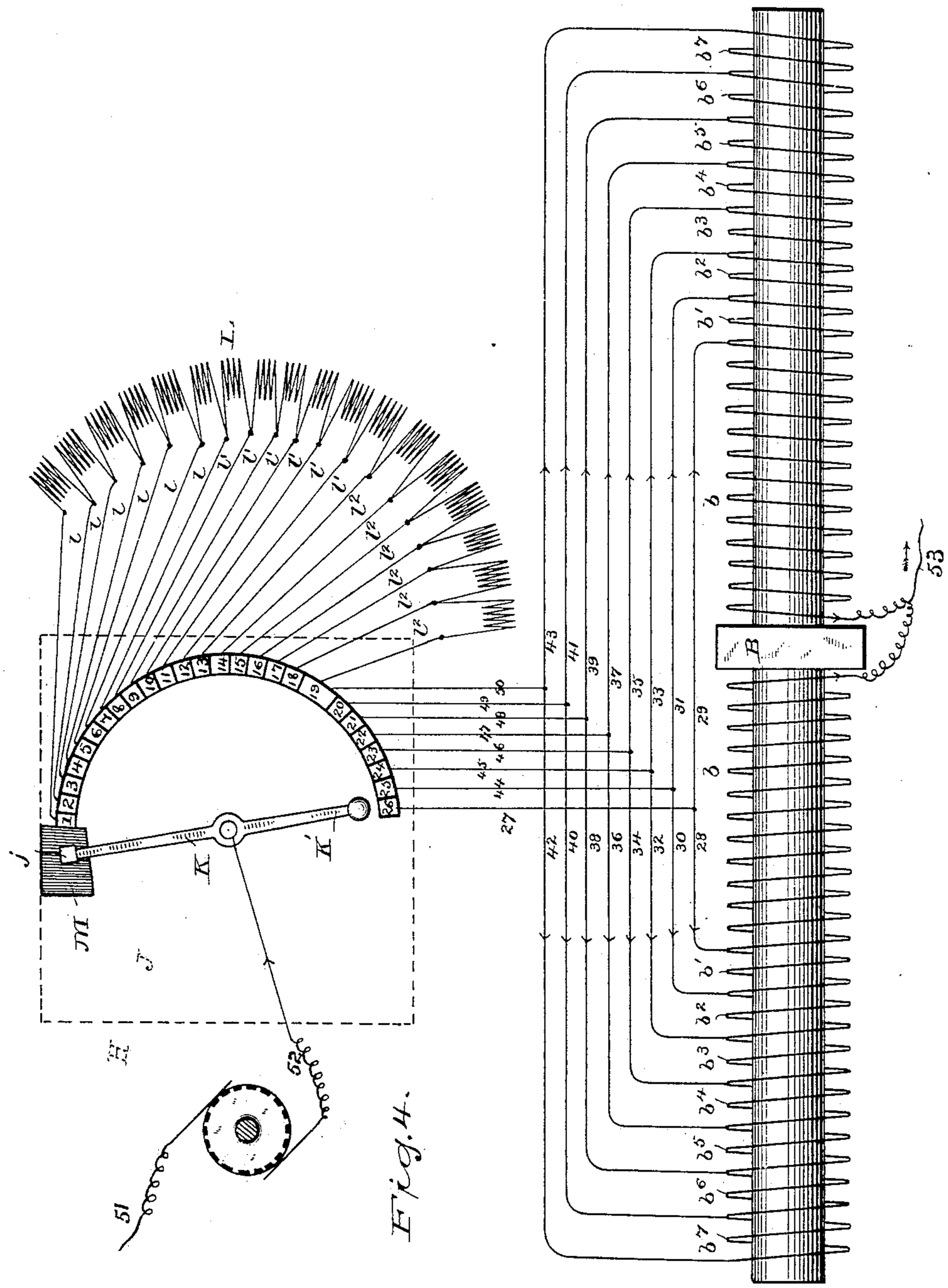

Fig. 4.

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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF CHICAGO, ILLINOIS.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 394,035, dated December 4, 1888.

Application filed June 6, 1888. Serial No. 276,261. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Chicago, in the county of Cook, State of Illinois, have invented certain new and useful Improvements in Electric-Railway Motors, of which the following is a description.

My invention relates to improvements in electric motors, and more especially in motors designed for the propulsion of vehicles, the object being to assemble and combine the several co-operating parts of a complete electro-dynamic motor or engine in a single structure.

The principles of construction and operation and the details of the arrangement of my improved motor will be hereinafter fully set forth, and referred to in the appended claims.

In the drawings illustrating my invention, Figure 1 is a view in elevation showing an electro-dynamic motor constructed according to my invention. Fig. 2 is a sectional elevation of the resistance-box and switch. Fig. 3 is a plan view of one layer or section of resistance-coils. Fig. 4 is a diagrammatic view showing the internal structure, arrangement, and electrical relationship of the several parts.

Similar letters denote like parts throughout.

The general plan of my motor is substantially similar to that shown and described in Letters Patent No. 347,902, dated August 24, 1886, but which for convenience will be briefly described herein.

A single field-magnet, A, is provided with magnetizing-coils *a a'*, fitted upon opposite end portions of an iron core formed with a central projecting part, B, at the neutral line. From the ends of the core A extend pole-pieces C D, between which is mounted an armature, E, preferably of the well-known "Gramme" type, the shaft *e* of which passes through a suitable bearing formed in the neutral part B of the field-magnet core, being provided with a pulley, F, or other power-transmitting device, at its said outer extremity. The opposite end of the armature-shaft *e* is supported in a bearing, F', formed in the end of a suitable arm or bracket, *f*, secured to the lower edge of the pole-piece D. Commutator-brush-holding devices G are provided, by means of which commutator-brushes *g g* are sustained in operative relation upon the commutator-cylinder E'. On top of the upper pole-piece, C, is placed a box, H, which may be constructed of any suitable non-conducting or non-combustible material. A structure formed of wood provided with a lining of asbestus, *h*, is found to answer every purpose. Within the box H are arranged a number of layers, I I, of resistance-coils, above which is a surface, J, provided at its upper side with a number of terminals numbered consecutively from 1 to 26, and arranged in segmental order in the path of the free end *j* of a pivoted switch-lever, K, provided with an operating-handle, K', on the exterior of the box H, said handle being also provided with an indicator, K^2, if desired.

The layers I of resistances referred to are constructed as follows: Upon a thoroughly-insulated frame, *i*, or frame constructed wholly of insulating material, adapted to be fitted into the box H, are secured at opposite sides a number of thin strips or pieces of metal, *k k*, and between the metallic strips *k k* are stretched a series of spiral springs, L, of German-silver or iron wire, of a size calculated to afford the desired resistance. The resistance-coils L are attached to the strips K, so that each layer or frame may constitute a single series. As indicated, one end of the first coil is connected to a single terminal, *k'*, its opposite extremity being connected to a strip of sufficient width to also receive one end of the next succeeding coil. The successive coils being connected at each end to strips to which also are connected the ends of preceding coils, series connection between the coils L will be established through the metallic strips to which their extremities are attached, the end of the last coil being connected to a single strip, *k'*, as in the first instance.

Independent connections *l* extend from each of the connecting-strips *k k'* at one side of the frame, so that connection may be made with any desired portion of each layer of resistance-coils. Any desired number of resistance-coils L may be employed. As herein shown, however, only three layers, I, of resistance-coils are placed in the box H, the series of terminals representing each layer be-

ing indicated at Fig. 1, at l l' l^2. As seen in Fig. 2, the last coil of one layer is connected to the first coil of the succeeding one by conductors l^4, so that all the resistance-coils are connected in series. The resistance-coils are connected by the terminals l l' l^2 to consecutive switch-terminals 1 to 19.

The field-magnets of my improved motor are so wound and connected that they include, first, a winding, b b, Fig. 4, calculated, when connected in a working-circuit in multiple arc, to maintain the desired strength of magnetic field when the armature is rotating at its highest speed, the armature then developing the maximum counter electro-motive force, which acts as a resistance to prevent more than the desired flow of current through said field-magnet coils. The field-magnet coils b b are connected to switch-terminal 26 by the conductor 27, which is connected to both of said coils in multiple arc by the branch conductors 28 and 29. Successive coils b' b^2 b^3 b^4 b^5 b^6 b^7 are superposed upon the windings b b, and also connected in multiple arc by conductors 30 31 32 33 34 35 36 37 38 39 40 41 42 43, and with the switch-terminals 25 24 23 22 21 20 19 through conductors 44 45 46 47 48 49 50. The conductor 50, leading to the exterior coils of the field-magnet, is connected to switch-block 19, which, it will be noted, is for convenience made of larger size than the others, and receives also the terminal of the last of the resistances, the outer end of the entire series of resistances being thus connected to the outer end of the entire series of field-magnet coils. It will thus be seen that when connection is made with block No. 1 of the switch the circuit will be completed through all the resistances L in series and through the entire system of field-magnet coils in multiple series. As ordinarily operated, the actuating-current is supplied to the armature through conductor 51, passing into and through the armature, and issuing thence through conductor 52, the current enters the switch-lever K, passing therethrough and through one or more of the resistances L in series, and through the entire system of field-magnet coils in multiple series, issuing through conductor 53, to which both field-magnet terminals are attached.

When the switch-lever is turned until the contact-block j rests upon the switch-terminal 19, the entire series of resistances will be cut out and the current will enter the field-magnet through its exterior coils, passing thence to the interior and out through conductor 53, the two portions of the field-magnet being shown, as indicated, in multiple arc. It will, however, be obviously within the scope of my invention, where greater resistance is desired, to permanently connect the field-magnet coils to form a single series, instead of a double one, as shown.

As the switch-lever is moved successively from the switch-terminal 19 to 20 21 22, &c., the auxiliary field-magnet coils will be cut out, and it should be so moved as the speed of the motor increases until, when the desired speed has been attained and the required counter electro-motive force developed in the armature, the switch-lever will be placed upon the terminal 26, (representing what I have called the "normal" field-magnet coils b b,) thus reducing the motor, when in full operation, to only those parts which are essential thereto. The upper surface of the division J, upon which the switch-terminals are placed, should be covered or formed of non-combustible material to prevent injury from the sparks formed when the circuit is opened and on cutting the motor out to stop it. I find it convenient, also, to provide a block of slate, M, or similar material, arranged adjacent to and on the same plane as the first of the series of switch-terminals. When the motor is not in operation, the switch-lever K should be turned until the moving contact j rests upon the said block M, as indicated in Fig. 4. To start the motor the lever K should be turned until the contact j is upon switch-terminal 1. The motor-circuit is then closed and the current from the armature must flow through all the resistances in series and then through all the field-magnet coils in multiple series, thus, in the absence of the retarding effect of counter electro-motive force in the armature, interposing the total wire resistance and preventing an abnormal rush of current and the consequent danger of short-circuiting the generator or overheating the coils of the motor. The additional field-magnet coils in circuit produce a higher degree of magnetism in the field of force and exercise a more powerful pull upon the armature, enabling it to develop at low speed the additional power necessary to start its load. As the speed of rotation of the armature increases and counter electro-motive force is developed, the internal resistance of the motor will increase until it is sufficiently high to prevent danger of short-circuiting the generator when the switch-lever K is turned and the resistance gradually cut out. Usually when the block 19 is reached a short pause will be made to give the armature time to reach the desired speed, when the switch-lever is gradually moved to the terminal 26 and the auxiliary field-magnet coils cut out.

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

1. In an electro-dynamic motor, the combination of a field-magnet wound with separable coils, a switch upon the motor provided with a continuous series of insulated terminals, connections between the portions of the field-magnet coils and part of the terminals of said switch, a series of artificial resistances connected to the remaining terminals of the switch, and a moving terminal and means for operating the same, whereby any portion of the artificial resistance may be connected in series with the field-magnet coils, or cut out altogether, substantially as described.

2. In an electro-dynamic motor, the combination of a continuous series of insulated terminals, a movable contact adapted to engage said terminals successively, a plurality of resistance-coils connected in series and divided into sections, each section connected to a separate terminal of the switch series, and a sectional field-magnet the parts of which are separately connected to the remaining terminals of the switch, the last coil of the resistance and the first coil of the field-magnet being connected to the same terminal, substantially as described.

3. In an electro-dynamic motor, the combination of a field-magnet wound with divisible magnetizing-coils, a switch having a series of separated terminals and connections between the said divisible field-magnet coils and part of said terminals, and a series of artificial resistances connected to other terminals of the said switch and adapted to be thereby connected in series with the field-magnet coils, substantially as described.

4. In an electro-dynamic motor, a field-magnet provided with main and auxiliary coils, said coils being wound and connected in two separate portions arranged in multiple relation to each other, connections extending from said multiple-arc coils to part of the terminals of a switch, and a series of resistances connected to other terminals of said switch, and arranged to be thereby connected in series with the coils of the field-magnet, substantially as described.

5. In an electro-dynamic motor, a field-magnet wound with main and auxiliary magnetizing-coils, a switch upon said motor comprising a series of separated terminals, to part of which the said coils are connected, an electric connection between one of the commutator-brushes and a movable switch-lever, whereby any desired portion of the auxiliary coils may be placed in circuit with the armature or the auxiliary coils entirely cut out, and an adjustable resistance connected to the remaining switch-terminals and arranged to be by said switch combined in whole or in part with the said field-magnet coils, substantially as described.

6. In an electro-dynamic motor, a field-magnet provided with main and auxiliary magnetizing-coils, a switch located upon the motor and provided with a series of separate terminals, to part of which the field-magnet coils are separately connected, a series of resistance-coils connected to other separate terminals of the same switch, a switch-lever for contact with any of said terminals, and an electric connection between one of the commutator-brushes and said switch-lever, whereby all or a part of the resistance, together with the field-magnet coils, or the field-magnet coils alone, or any portion thereof, may be placed in circuit with the armature, substantially as described.

In testimony whereof I hereto affix my signature in presence of two witnesses.

CHARLES J. VAN DEPOELE.

Witnesses:
W. A. STILES,
JOHN EASON.