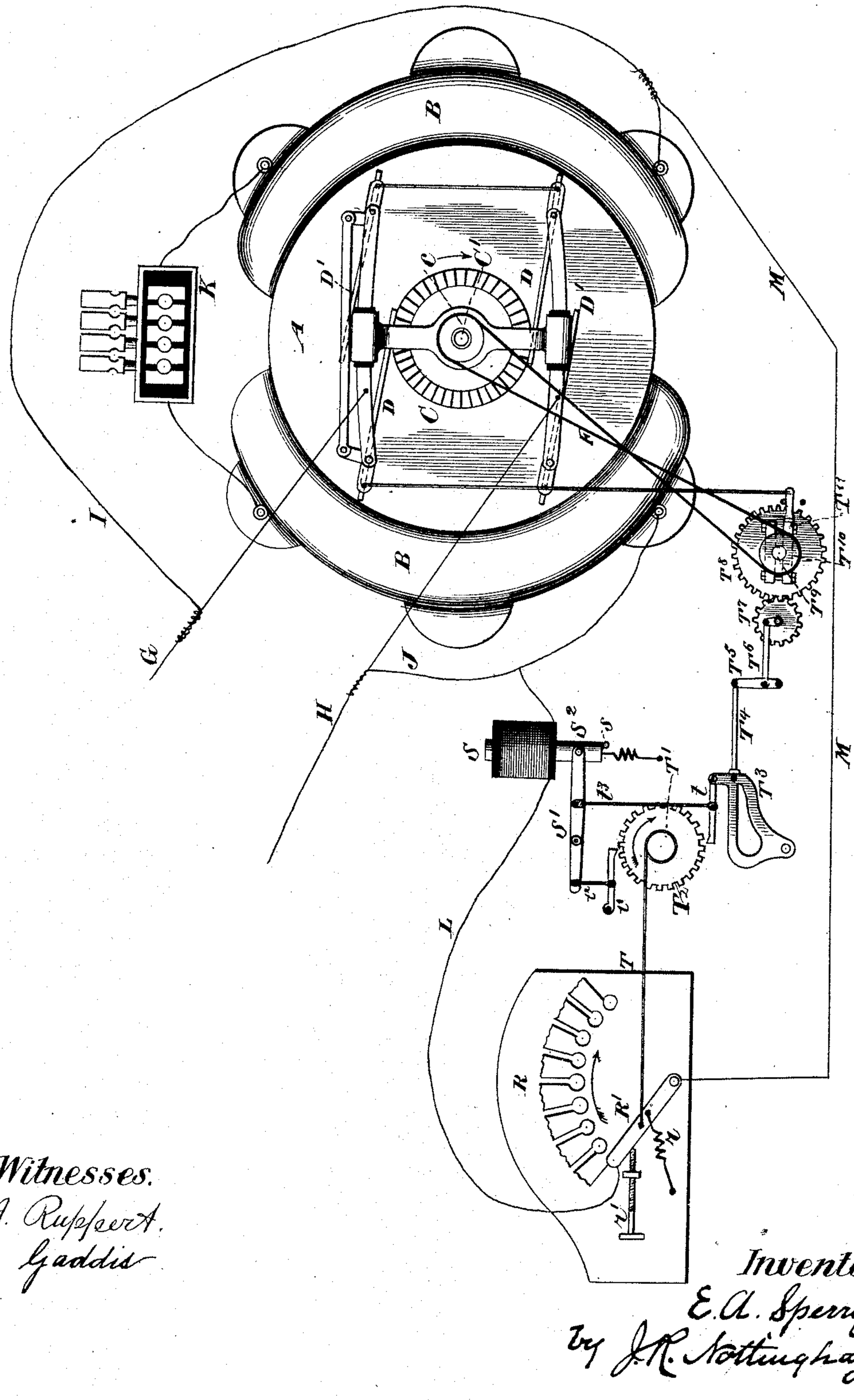
(No Model.)

E. A. SPERRY.

ELECTRIC MOTOR.

No. 353,987. Patented Dec. 7, 1886.



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UNITED STATES PATENT OFFICE.

ELMER A. SPERRY, OF CHICAGO, ILLINOIS.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 353,987, dated December 7, 1886.

Application filed October 13, 1883. Serial No. 108,912. (No model.)

To all whom it may concern:

Be it known that I, ELMER A. SPERRY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Motors, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improvement in electric motors of that class in which the field-magnets are excited by an electric current on a derivation from the main circuit which supplies the motive current to the armature.

It is well known that when the armature of an electric motor is rotated at high speed a counter electro-motive force is developed therein, which very seriously counteracts the main current, and frequently so reduces the capacity of the machine as to render it ineffective for many purposes. Electric motors have been constructed with resistances so proportioned that the maximum development of power is at high speeds; but in such machines is found the disadvantage that at low speeds their power is disproportionately small, so that a comparatively high speed must be maintained, even when but little power is required to be exerted by the machine.

It is the object of my improvement to cause the counter electro-motive force developed in the armature to so act upon the field-magnets as to augment the magnetism thereof in almost the exact ratio that the energy in the armature is depreciated by the counter-current, thus rendering the resultant from the joint forces of armature and field a practically uniform quantity, not affected appreciably by the speed of the armature, but being a legitimate exponent and utilization of the effect of the main or supplied motive current.

It is further the object of one feature of my invention to prevent the field-magnets from reaching magnetic saturation before the armature has reached the desired speed after the machine is started into operation.

My invention consists in certain novel constructions and combinations of parts and arrangements of circuits, which will be readily understood from the following particular description and the accompanying drawing, which represents a diagrammatic front view of an electric motor provided with my improvements.

The letter A indicates the rotary armature, and B B the pole-pieces of the field-magnets of an electric motor.

C is the commutator.

D D and D′ D′ indicate two pairs of commutator-brushes, which are automatically shifted to correspond in position with the direction of rotation of the commutator, as will be hereinafter explained.

G and H are the wires of the supply-circuit, and I and J indicate a derived circuit in which are connected the helices of the field-magnet, said helices not being shown as the manner of their connection in the derived circuit will be readily understood. In this derived circuit is also included an adjustable rheostat, K, so that the current which excites the field-magnets can be regulated as desired.

L and M are the wires of a sub-shunt or derivation, which will be hereinafter referred to.

The operation of the devices for preventing adverse effect of the counter electro-motive force developed in the armature will be understood from the following explanation: The resistance of the field is such that by slight extra adjustment of the rheostat K it is accurately proportioned to that of the armature. When the motor starts and runs at low speed, the opposing electro motive force developed in the armature is slight, and the energy in each derivation of the circuit is practically in proportion to the resistance of the conductors, the resistance of the field-coils being such that the magnetism developed in the pole-pieces B B is below the point of magnetic saturation of the iron. Now, when the speed of the armature increases, the counter current developed in its coils tends in opposite direction to the current traveling on the main conductors H and G to the points of junction of wires J and I with said conductors, and opposes resistance to the passage of the main current to the armature, the tendency being to drive the main current backward to the junctions of wires J and I with the main conductors G and H, where passage is offered of uniform resistance, so that an increase of current flows in a derivation including the field-coils and aug-

ments the magnetism of the field-magnets as the energy of the armature is decreased, thus making the resulting force of the united energies of the armatures and field a practically constant quantity, as before stated.

It sometimes happens that there is developed in the field-magnets a tendency to reach their saturate points too early—that is, before the speed of the armature has sufficiently increased after being started. In order to prevent this I have provided the following devices.

The letter R indicates a variable rheostat, one end of which is connected through the coil of an axial magnet, S, with the wire J of the field-circuit, and the pivoted shunting-arm R′ of this rheostat is connected by wire M with the wire I of the field-circuit, so that the rheostat R and magnet S are in a sub-shunt or derivation from the field-circuit. The arm R′ is held toward the end of the rheostat, to which the wire L is attached by means of spring *r*, said arm resting against an adjustable stop, *r′*, by which its normal position with respect to the coils of the rheostat may be determined. To the opposite side of the arm R′ is attached one end of a cord, T, the other end of which is secured to a shaft, T′, upon which is fixed a toothed wheel, T^2. Directly under this wheel is pivoted an arm, T^3, to the upper end of which is pivoted one end of a pawl, *t*, the other end of which is arranged to be engaged at the proper time with the teeth of wheel T^2, as will presently appear. A pawl, *t′*, is arranged to prevent said wheel from turning under the influence of spring *r*. The pawl *t′* is connected by a cord, t^2, with the free end of a lever, S′, which is pivoted above the wheel T^2 by a fixed pivot near the end to which the cord t^2 is attached, the other end of the lever being pivoted to the lower end of the movable core S^2 of the magnet S, the downward movement of which is limited by a suitable stop, *s*. To one side of the arm T^3 is connected one end of an arm, T^4, the other end of which is pivoted to a vibratory arm, T^5, which is connected by a pitman-rod, T^6, with a wrist-pin projecting from a toothed wheel, T^7, which gears with a toothed wheel, T^8, fixed upon a shaft, T^9, which carries a belt-pulley, T^{10}, this belt-pulley being connected with a similar pulley, *c*, on the shaft of the armature by means of a belt, F.

It will now be observed that when the armature-shaft is in rotation, a rotary motion will be communicated to wheel T^8 and thence to the wheel T^7, from which a vibratory motion will be transmitted through the rod T^6 to arm T^5, and from this arm a similar motion will be communicated to the arm T^3 through rod T^4, so that while the motor is in operation the arm T^3 will be kept in constant vibration. When the magnet S is not excited, its core S^2 will rest upon the stop *s*, and the end of lever S′ will be held in such position that the pawl *t*, supported from the lever S′ by the cord t^3, will be out of engagement with the wheel T^2; but when said magnet is excited the pawl *t* will be raised into engagement with the wheel T^2, and, owing to the vibratory movement of arm T^3, the pawl will turn said wheel in the direction indicated by the arrow, causing the cord T to be wound upon the shaft T′, and draw the arm R′ in the direction indicated by the arrow on the rheostat, so as to include additional resistance in the circuit in which said rheostat is connected.

The operation of these devices is as follows: When, owing to the strength of the main current and the derivation thereof in the field-circuit, there is a tendency of the field-magnets to reach their saturation-point before the armature has attained a sufficient speed, a portion of the current in the field-circuit will be diverted through the subderivation, indicated by the letters L and M, and thus the current in the field-circuit will be reduced sufficiently to prevent the magnetic saturation of the iron in the field-magnet cores. The quantity of current in the field-circuit will, however, be gradually increased, owing to the fact that the current in the subderivation excites the magnet S and causes its core to be drawn upward, thus raising the pawl *t* into engagement with the wheel T^2, so that said wheel will be turned, causing the cord T to be wound up slowly and gradually move the arm R′ to such position that a sufficient resistance of the rheostat R will be included in the subderivation to drive the current back to the field-circuit, or, rather, to prevent its being diverted therefrom. When this condition of affairs is reached, the magnet S ceases to be excited, and the pawl *t* is lowered out of engagement with the wheel T^2, which is, however, prevented from turning backward by the pawl *t′*, this pawl being thrown out of engagement to allow the rheostat R to resume its normal condition when the motor is stopped.

It will now be seen that by the devices I have described and just explained the current in the field-circuit is prevented from being too strong at the start, however strong may be the main current supplied to the armature, and will be gradually increased in strength, so that the cores of the field-magnets will not reach the point of saturation until the armature has had ample time to attain a proper speed of rotation.

The brushes D D and D′ D′ are arranged for alternate contact with the commutator by means of mechanism connected with a friction-clamp, T^{11}, which embraces the shaft T^9. It will be readily observed that this friction-clamp and devices connecting the same with the brushes will serve to change the direction of rotation of the shaft T^{19} whenever there is a change of direction in the armature.

Having now fully described my invention, and explained the operation thereof, I claim—

1. In an electric motor, the combination, with a circuit derived from the main circuit and arranged to excite the field-magnets, of a subderivation from said derived field-circuit and an automatic rheostat included in said

subderivation and arranged to gradually increase the resistance thereof, substantially as and for the purpose set forth.

2. The combination, with the main circuit which supplies the armature and the derived circuit including the coils of the field-magnet, of a sub shunt or derivation from the field-circuit, the variable rheostat and solenoid-magnet included in said sub-shunt, the movable rheostat-arm, connecting cord, toothed wheel, retaining-pawl, actuating-pawl, pivoted lever, solenoid-core, and mechanical devices, substantially as described, for moving the toothed wheel and adjusting the rheostat from the shaft of the motor, substantially as set forth.

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

ELMER A. SPERRY.

Witnesses:
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ALLEN A. GRIFFITH.