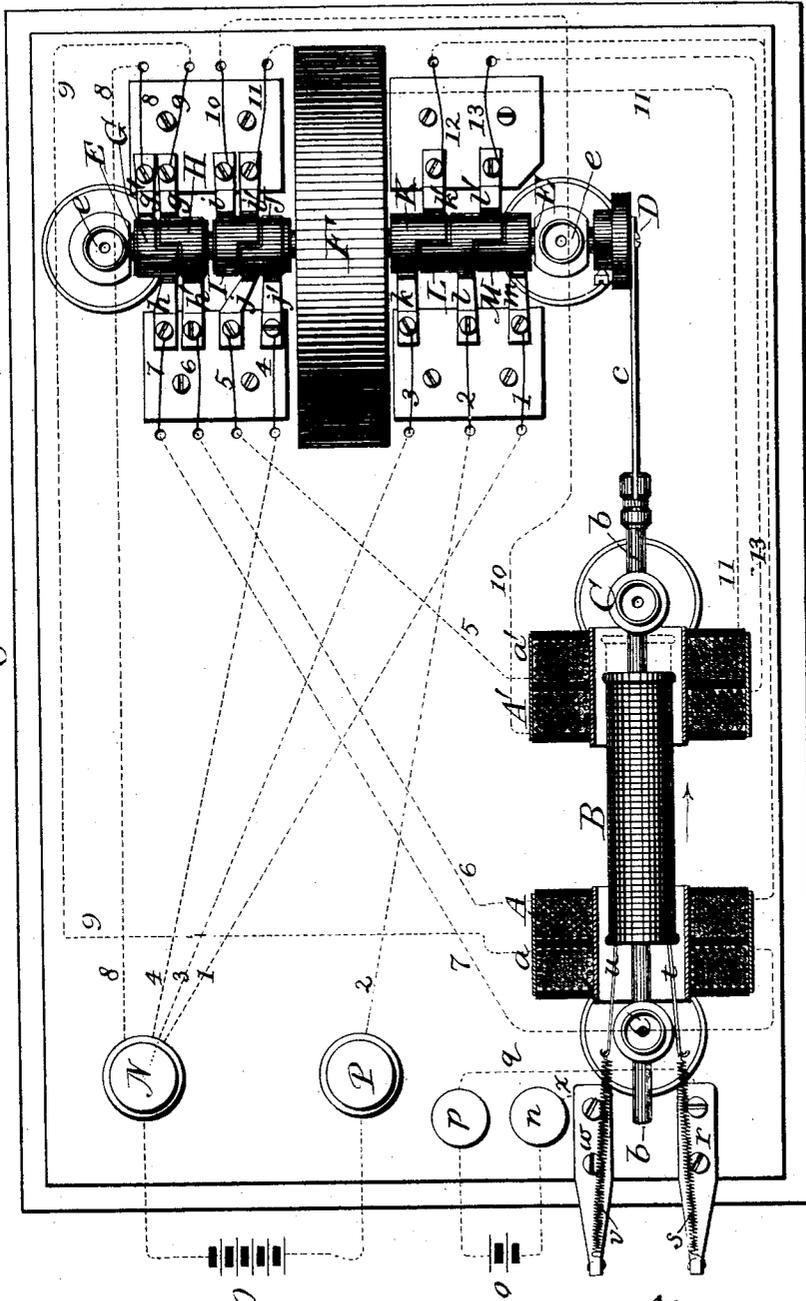


M. G. FARMER.
ELECTRO MAGNETIC MOTOR.

No. 243,765.

Patented July 5, 1881.

Fig: 1.



Witnesses:
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 Miller & Paul

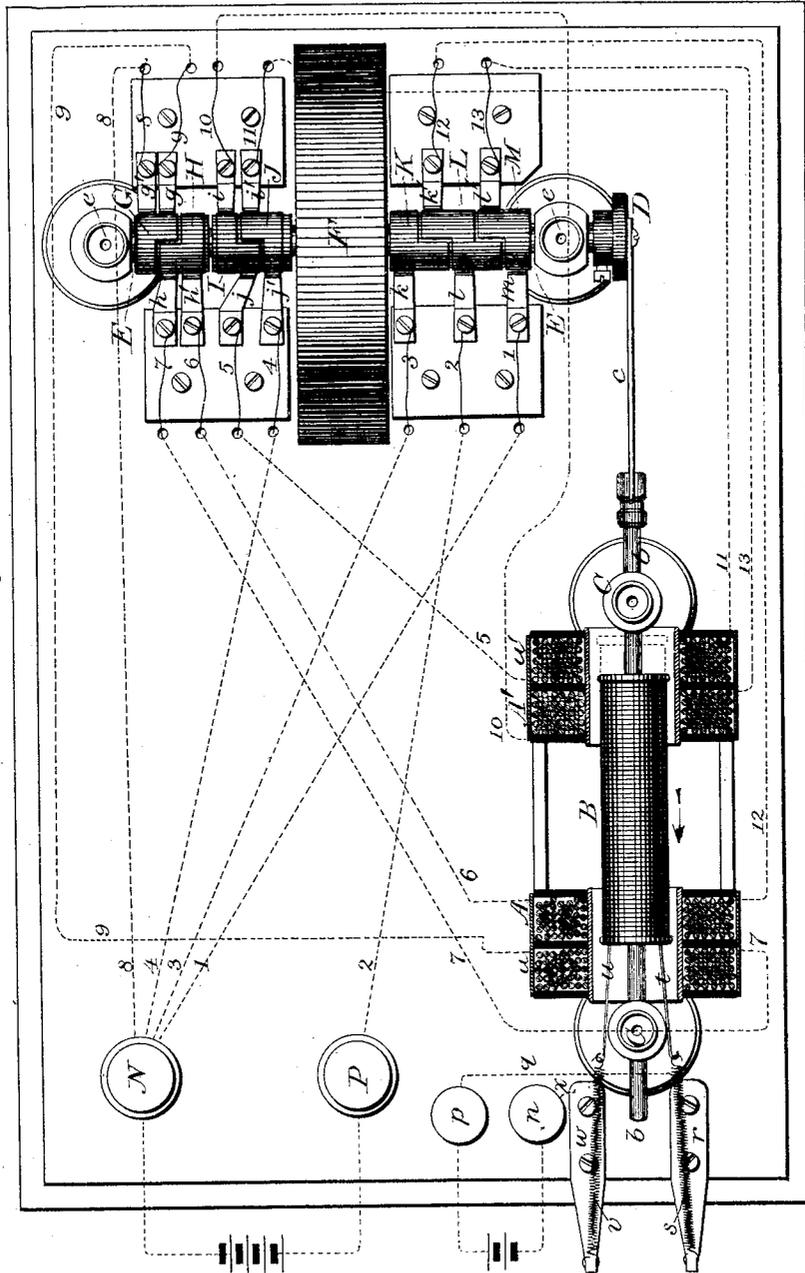
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 Moses G. Farmer,
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Fig. 2.



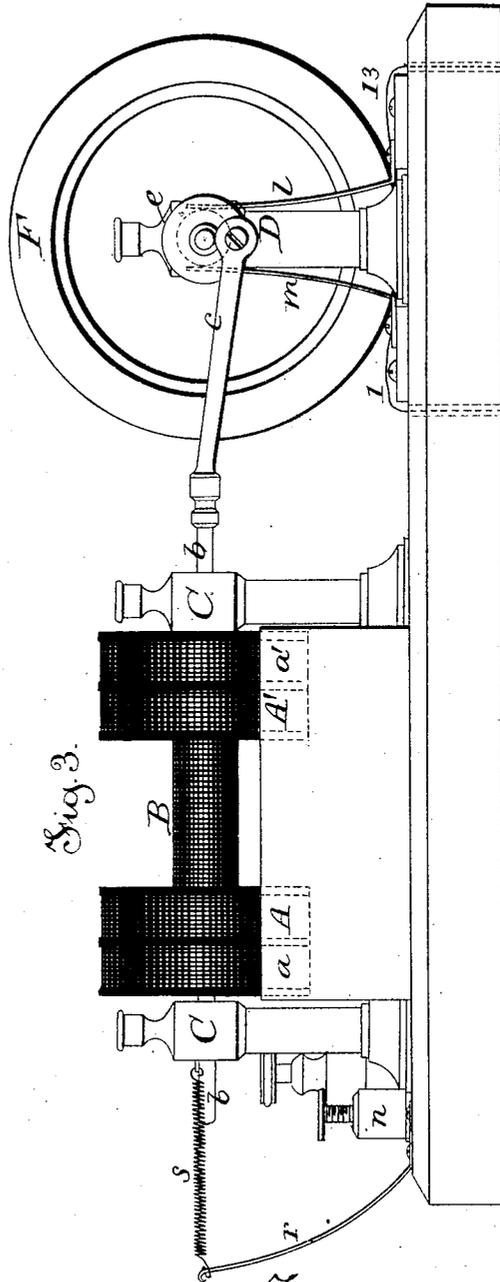
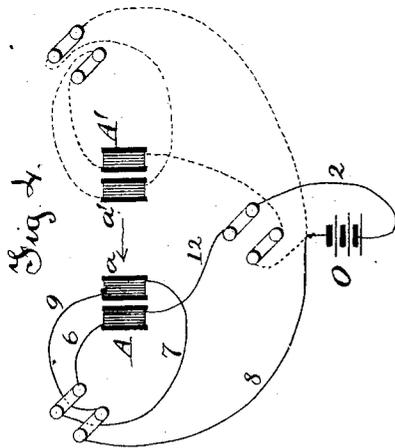
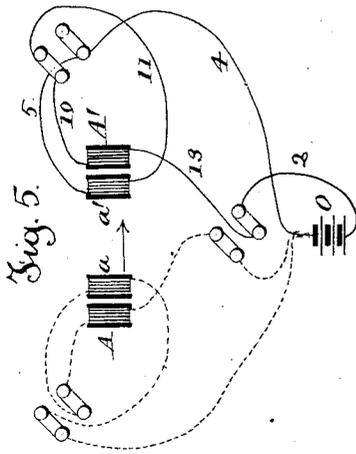
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see witnesses;
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Inventor;
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UNITED STATES PATENT OFFICE.

MOSES G. FARMER, OF NEWPORT, RHODE ISLAND.

ELECTRO-MAGNETIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 243,765, dated July 5, 1881.

Application filed March 25, 1881. (No model.)

To all whom it may concern:

Be it known that I, MOSES G. FARMER, a citizen of the United States, residing at Newport, in the county of Newport and State of Rhode Island, have invented certain new and useful Improvements in Electro-Magnetic Motors; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings.

In Letters Patent of the United States No. 126,627, granted to me May 14, 1872, I have described a circuit-closing device by means of which the ends of an electro-magnetic coil or helix are united just before the connection between the helix and the electrical generator is broken, whereby the spark due to the discharge of the extra or induced current from the coil is prevented.

In Letters Patent No. 126,628, also granted to me May 14, 1872, I have described and shown an electro-magnetic motor in which a practical application of this device is made use of, the ends of the actuating-helices being automatically united by means of a commutator moving with the motor just before the helices are disconnected from the generator.

My present invention relates to certain improvements in the class of electro-magnetic motors hereinbefore referred to, by which the effects of the induced current are diminished or destroyed, and by virtue of which the efficiency of the said motors is greatly increased and the expense of operating the same diminished.

My invention consists in making use of one or more pairs of helices arranged to act upon a soft-iron armature or movable core, and in connecting the said helices with the generator by means of an automatic commutator operated by the movement of said core or armature in such a manner that during the movement of the latter in either direction the two helices which are thus simultaneously in action are included in the same circuit and exert their attractive forces in the same direction upon the core or armature, while at the completion of the stroke the terminals of the pair of helices are first united, so as to form a closed circuit, before the battery-current is cut off from them, and I so arrange the commutator with reference to the terminals of the

helices that when thus united the connections are such that the induced current generated within them by the magnetic discharge of the core or armature tends to traverse the respective helices in opposite directions. Thus the current of induction set up in each helix of the pair neutralizes that in the other, and the total effect upon the armature becomes inappreciable.

In the accompanying drawings, Figures 1 and 2 are plan views, partly in section, of an electro-magnetic motor embodying my improvements, shown in two different positions. Fig. 3 is a side elevation of the same. Figs. 4 and 5 are theoretical diagrams, illustrating the circuit-connections in different positions of the motor.

In the figures, $A a A' a'$ represent four helices or coils of insulated wire of the usual construction. These are grouped in two pairs, in such a manner that the pairs are capable of acting alternately upon a cylindrical armature of soft iron, B , which is itself enveloped in a coil of insulated wire, as hereinafter described. The armature B , which also forms the core of the four helices hereinbefore referred to, is mounted upon a horizontal rod, b , which slides freely to and fro in suitable guides, $C C$. The armature B moves freely within the central opening of the helices, which latter are arranged in two groups or pairs, A and a being at one end of the armature and A' and a' at the other end, the whole arrangement forming, in fact, a compound axial magnet. The armature B is caused to move to and fro by the alternate magnetic attraction of the helices $A a$ and $A' a'$, in a manner which will hereinafter be explained.

Attached to the sliding rod b is a pitman, e , which takes hold of the crank D on the end of a horizontal axis or shaft, $E E$, which is mounted in suitable bearings, $e c$. Upon this axis is fixed a fly-wheel, F , the whole arrangement being somewhat similar to that of the cylinder, piston, crank, and fly-wheel of a horizontal steam-engine.

Upon the shaft E are mounted a series of commutators, G, H, I, J, K, L , and M , the function of which is to automatically control the distribution of the electric current from the generator to the four helices $A a A' a'$, as hereinafter set forth. Each commutator consists of a section

of a metallic cylinder or ring mounted concentrically upon the shaft $E E$, and each of the rings is insulated from the shaft and from the other rings. The series of insulated contact-springs $g g' h h'$, &c., are mounted upon the base of the machine and press against the cylinder sections or commutators upon the shaft, and thus form electrical contact with the latter as they revolve. The adjacent ends of the commutator cylinders or rings are provided with recesses and projections arranged with reference to each other in a manner which will be best understood by inspection of Figs. 1 and 2, so that parts of two different rings may be brought in contact with one and the same contact-spring during different portions of one revolution. These several contact-springs which press against the revolving commutator-rings constitute the terminals of wires leading respectively to the poles of the electric generator and to the helices which act upon the movable armature to impel the machine, and the function of the revolving commutator-rings is to form the required connections and disconnections between these two sets of conductors. The coil which is wound directly upon the armature B is traversed by a constant current of electricity from a suitable battery or other generator, o , the respective poles of which are connected with the binding-screws $p n$. The electric current is conducted from the binding-screw p by a wire, q , to a standard, s ; thence by a spiral wire, r , to the terminal t of the coil surrounding the core or armature B ; thence by terminal u and spiral wire v to a standard, w , from which a wire, x , leads to the other binding-screw, n . The armature B thus becomes a permanent or constantly-polarized magnet by virtue of the constant current passing round it from the generator o .

In Fig. 1 the armature is represented as in a position midway of its stroke and moving in the direction indicated by the arrow. The course of the actuating electric current may be traced as follows:

O represents a battery, dynamo-electric machine, or other suitable electric generator, the positive and negative poles of which are respectively connected with the binding-screws P and N upon the base of the electro-motor. Commencing at the positive pole of the generator O , the current goes first to the binding-post P , and thence by the wire 2 to the contact-spring l , through the commutator-ring L to the spring l' ; thence by the wire 13 to the helix A' , passing through said helix, and thence by the wire 10 to the commutator-spring i ; thence to the ring I , spring i' , and wire 11 to the other helix, a' , of the pair, through said helix, and thence by wire 5 to contact-spring j , commutator-ring J , and spring j' , and thence by wire 4 to the binding-screw N and negative pole of the generator.

It will be observed that the organization of the circuits is such that the current whose course has just been described traverses the

helices $A' a'$ in the same direction. The effect of this arrangement is that both helices act in this same manner upon the adjacent end of the polarized armature B , exerting a powerful attraction upon it and tending to pull it in the direction indicated by the arrow until the fly-wheel F has been caused to revolve by means of the crank D through one-fourth of a revolution. At this moment the direction of the electric circuits is changed throughout by the action of the commutators upon the shaft $E E$, which then assume the position shown in Fig. 2. In the new position of the commutators the course of the circuit is as follows: from the positive pole of the generator O to the binding-screw P ; thence by the wire 2, contact-spring l , commutator-ring L , spring l' , and wire 12 to the helix A ; thence by wire 6, contact-spring h' , commutator-ring H , contact-spring h , and wire 7 to helix a ; thence by wire 9, contact-spring g , commutator-ring G , contact-spring g' , and wire 8 to the binding-screw N and negative pole of the generator. Thus it will be understood that by this movement of the commutator the helices A' and a' are disconnected from the generator and the helices A and a are connected with it, while by the same operation the terminals of the helices A' and a' are united by the commutator, as will be understood by tracing the connections in Figs. 2 and 5 from the helix A' , by the wire 10, contact-spring i , commutator I , contact-spring j , and wire 5, to helix a' ; thence by wire 11, contact-spring i' , commutator-ring J , contact-spring j' , wire 4, binding-screw N , wire 1, contact-spring m , commutator-ring M , contact-spring l' , and wire 13 to the other terminal of the helix A' . This latter circuit is, in fact, completed immediately before the disconnection of the generator, as the construction of the commutator is such that the springs are in contact momentarily with two commutator-rings at the same time while passing from one to the other. The effect of this arrangement is, that the closed circuit, which is formed by uniting the terminals of the two helices A' and a' , traverses them in opposite directions after the generator has been detached. Therefore the inductive action which is set up in each helix upon the appearance of the magnetism of the core is precisely equal and opposite to that in the other one, and the two induced currents therefore reciprocally neutralize or destroy each other, so that by my improved organization the action of the induced current upon the core, which seriously impairs the efficiency of ordinary electro-motors, is entirely done away with.

It will sometimes be found advantageous in practice to set the commutator a little in advance of the movement of the armature, giving it, as it is technically termed, a "lead." In such case the terminals of each pair of helices would be united and the generator disconnected just before the completion of the stroke.

The connections of the circuits in the two po-

sitions of the commutators during the direct and the return stroke, respectively, will be more readily understood by reference to the diagrams, Figs. 4 and 5, in which the two positions of the commutators are respectively illustrated. The full lines show the circuits traversed by the electric current from the generator, while the dotted lines show the circuits in which the terminals of the coils are united after the disconnection of the generator. The arrows in these figures indicate the direction in which the core or armature is supposed to be moving.

It is obvious that many changes may be made in the construction and arrangement of the details of my apparatus without departing from the spirit of the invention. Various well-known forms of commutators might be advantageously employed in order to produce the effects which I have described. So, also, a permanently-polarized steel bar might be employed for the reciprocating armature, or even a non-polarized soft-iron bar; but neither of these would be as efficient in practice as the construction which I have described, and which I consider preferable to any other known to me.

I claim as my invention—

1. The hereinbefore-described method of neutralizing or destroying the induced current generated in the helix of an electro-magnet upon the cessation of the primary current traversing the same, which consists in uniting with each other the respective opposing terminals of the

two sections of the divided helix, and thereby forming a closed circuit immediately upon the disconnection of the generator.

2. The combination, substantially as hereinbefore set forth, of two helices included in the same circuit and acting in unison upon the same core or armature, a commutator automatically operated by the movement of said core or armature, and circuit-connections, substantially such as described, whereby the connections of the terminals of the respective helices are reversed, so that a current is made to traverse said helices alternately in the same and in an opposite direction with reference to each other.

3. The combination, substantially as hereinbefore set forth, of a movable core or armature, two helices or coils arranged to act simultaneously upon said core or armature to impel it in a given direction, a commutator automatically operated by the movement of said core or armature, and circuit-connections, substantially such as described, from the commutator to the helices, whereby the opposing or like terminals of said coils are united at the termination of the stroke to form a closed circuit before the disconnection of the generator.

In testimony whereof I have hereunto subscribed my name this 22d day of March, A. D. 1881.

MOSES G. FARMER.

Witnesses:

DARIUS BAKER,
SARAH J. FARMER.