(Model.)

C. A. RANDALL.

Electro-Magnetic Motor.

No. 228,116. Patented May 25, 1880.

Fig. 1.

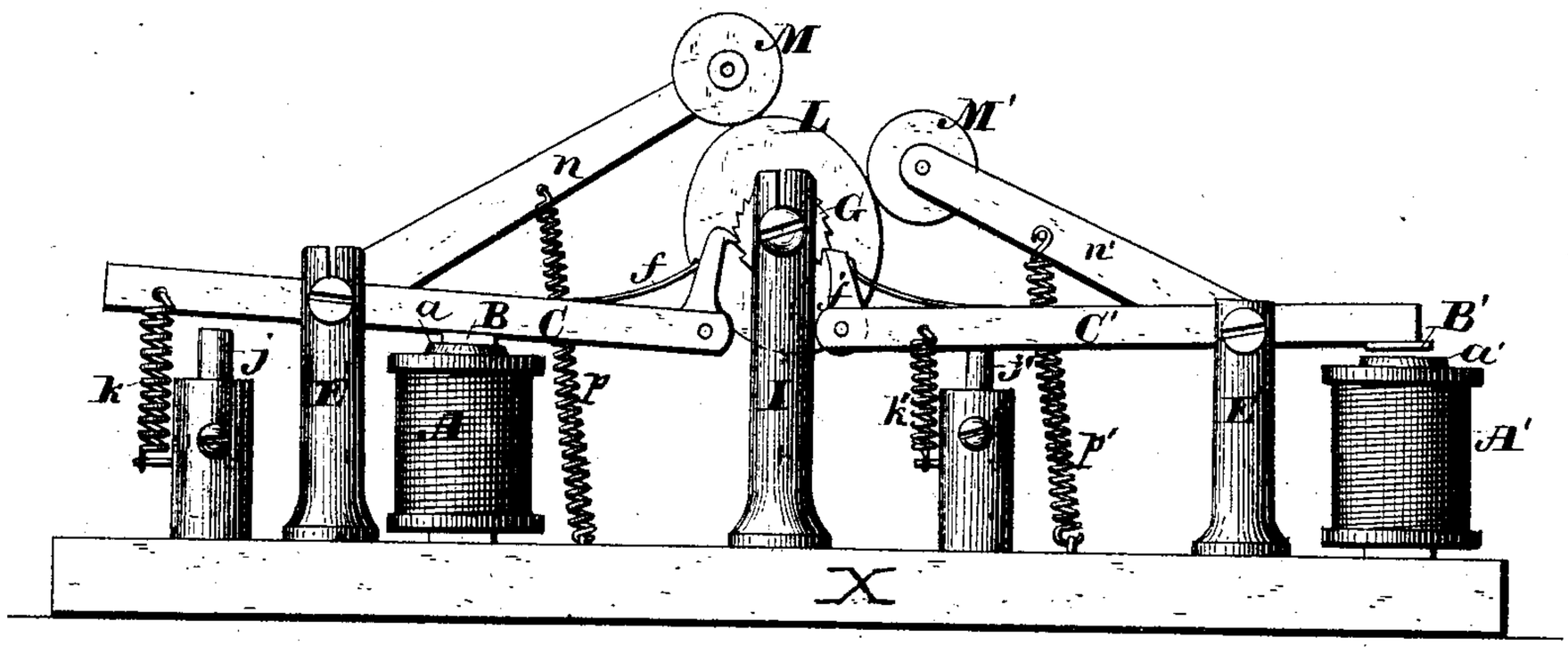


Fig. 2.

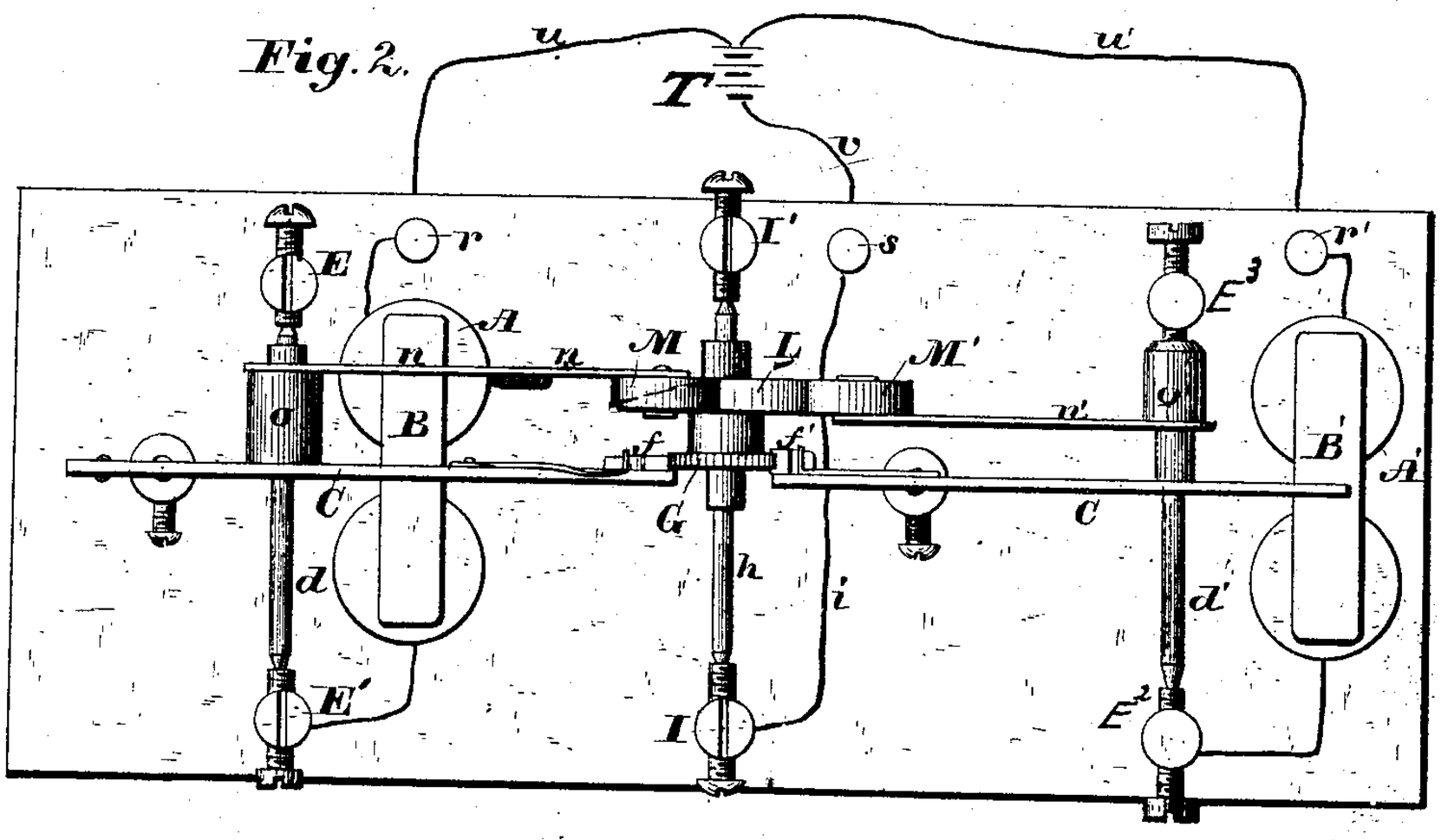


Fig. 3.

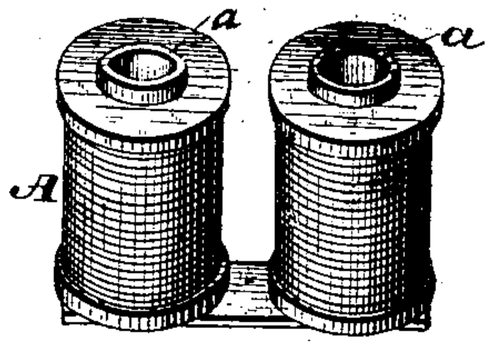
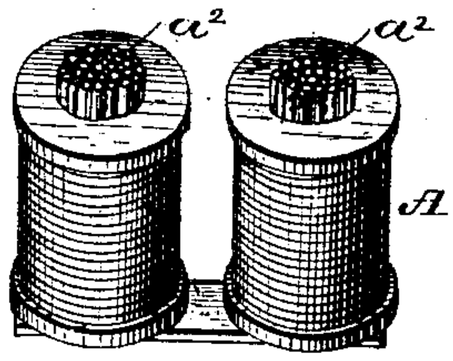


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES A. RANDALL, OF NEW YORK, N. Y.

ELECTRO-MAGNETIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 228,116, dated May 25, 1880.

Application filed March 2, 1880. (Model.)

To all whom it may concern:

Be it known that I, CHARLES A. RANDALL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Electric Engines, of which the following is a specification.

This invention relates to electro-magnetic engines in which provision is made for changing a battery-current from one or more electro-magnets to another or others by means of one or more commutators.

It has been customary in the construction of electro-magnetic engines to use magnets having large iron cores wound with coarse wire and requiring quantity current of great strength to charge them. Such magnets I believe to be not the most efficient, for although under proper conditions they are very powerful, they cannot be rapidly magnetized to a maximum power nor become quickly discharged when the current ceases to flow. It is of prime importance in these engines that the magnet shall exert its entire maximum power to move the armature to a certain point, and then become suddenly discharged in order to prevent retardation of the armature in its further movement, whether such further movement be the result of acquired momentum, the attraction of another magnet, or the force of a spring.

The commutators or current-changers heretofore used in electro-magnetic engines are virtually circuit-breakers, contact between a spring contact-plate and one metallic portion of the commutator being completely broken and made with another at every change of the current from one magnet to another, and at every such break and make there is a spark, caused by escaping electricity. This escape results in a great loss of power from the magnets, and the spark soon corrodes and renders inefficient the contact-points.

It is the object of my invention to remedy the defects of construction above referred to; and to this end it consists, first, in the combination, in an electric motor, with one or more movable armatures, of a movable shaft connected therewith by intermediate devices, one or more electro-magnets arranged to act upon said armature or armatures and provided with cores formed of soft-iron tubes or bundles of soft-iron wires, and a commutator operated by said shaft to cause said magnet or magnets to be alternately charged and discharged by variation of contact between conductors without disconnection of said conductors, as hereinafter fully described; second, in a commutator or current-changer in which the electric current is caused to flow from a main conductor to one or another of several branch conductors in contact therewith by increasing the contact-pressure between the said main conductor and the branch conductor over which the current is desired to flow, whereby an actual break of circuit is avoided and a consequent escape of electricity and burning of contact-points by the spark is obviated; third, in a commutator or current-changer in which a main conductor is formed of carbon and branch conductors are arranged to bear thereupon with varying pressure.

In the accompanying drawings, Figure 1 is a side elevation of an electro-magnetic engine constructed according to my invention. Fig. 2 is a plan view of the same. Fig. 3 is a detached view of an electro-magnet with tubular core, and Fig. 4 is a view of a magnet with a core formed of wires.

The letters A and A′ designate two electro-magnets in independent circuits and magnetically insulated from each other and all other parts of the machine, said magnets being arranged upon a base, X, of wood or similar insulating material. The cores *a a′* of these magnets are preferably tubular, as shown in Fig. 3, and formed of soft iron; or said cores may be formed of a collection of parallel soft-iron wires, as shown in Fig. 4. Both of these forms of cores have, relatively to their coils, a great extent of surface, and are therefore capable of being very rapidly magnetized and demagnetized, or charged and discharged. The size of the electro-magnets depends, of course, upon the power the engine is intended to have, the strength of battery to be used, and the relative sizes of the other parts. I prefer to make them short and with cores as light as consistent with the work to be done.

The armatures B and B′ of these magnets are arranged directly in front of the ends of the cores *a a′*, and are secured to the ends of

levers C C′, extending toward each other and fixed upon rocking arbors *d d′*, journaled respectively in standards E E′ and E² E³. At their inner ends the levers carry pivoted spring-impelling pawls or dogs *f f′*, respectively, which engage with the teeth of a ratchet-wheel, G, fixed upon an arbor, *h*, the opposite ends of which are journaled in standards I I′. The pawl *f* is adapted to move the ratchet-wheel G by moving downward, and the pawl *f′* is adapted to turn the said ratchet by moving upward from the base. Adjustable stops *j j′* limit the retractile movements of the levers C C′, which are, of course, as well as their direct movements, in opposite directions, and retractile springs *k k′* draw said levers toward these stops.

Upon the arbor *h* is fixed an oval or double eccentric disk, L, formed of carbon, and upon the periphery of this disk bear two carbon rollers, M M′, pivoted respectively to the ends of metallic arms *n n′*, the opposite ends of which are fixed to metallic sleeves *o o′*, closely embracing but rocking upon the arbors *d d′* respectively. The rollers M M′ are drawn toward and caused to press upon the disk L by springs *p p′*, which are connected with the arms *n n′* and the base. The rollers M M′ are so arranged with respect to oval disk L that while one of said rollers bears upon that portion of the periphery of said disk which is farthest from its center the other roller will bear upon that portion of the periphery which is nearest to its center, the roller at the greatest distance bearing with the greatest pressure and making the best contact, of course, because its spring is placed under tension by the arm being swung upward. The other roller, bearing on the disk at the shortest distance from its center, makes comparatively poor contact with the disk, because the spring which draws it toward said disk is under but slight tension.

One terminal of the coil of magnet A is connected with a binding-post, *r*, and the other terminal with the metallic standard E, which supports one of the bearings of the arbor *d*, while one terminal of magnet A′ is connected with a binding-post, *r′*, and the other with the metallic standard E², which supports one of the bearings of the arbor *d′*. The metallic standard I, which supports one of the bearings of the arbor *h*, is connected by a wire, *i*, with a binding-post, *s*.

The letter T indicates a battery, one pole, +, of which is connected with both the binding-posts *r r′* by wires *u u′*, and the other pole, —, with the binding-post *s* by a wire, *v*.

The battery-circuit being closed and the parts in position as shown in Fig. 1, the operation is as follows: The current flows over wire *v* to post *s*, over wire *i*, standard I, and arbor *h* to oval carbon disk L, where it is divided, a portion flowing through each of the rollers M and M′ and through their connections back to the battery. In practice, however, but a very small portion of the current will flow to roller M′, because of its poor contact with the disk—not sufficient to charge the magnet A′. Nearly all the current will flow through roller M, on account of the strong pressure with which it makes contact with the disk L, and from the said roller M it flows over arm *n*, arbor *d*, standard E, coil of magnet A, screw-post *r*, and back to battery. In its passage over the coils of magnet A it induces magnetism in the cores *a* of said magnet, and these cores attract the armature B, move the lever C, and cause the dog or pawl *f* to move the ratchet-wheel G, arbor *h*, and disk L one-fourth of a revolution, thus bringing the disk and rollers M M′ into such position that the roller M′ then bears with the greatest pressure upon the disk L and the roller M with the slightest, and the battery-current will consequently change, and instead of flowing to and through roller M, as at first, it will flow over roller M′, arm *n′*, arbor *d′*, standard E², coils of magnet A′, and back to battery, charging the cores of magnet A′ and causing them to attract the armature B′ and move the lever C′, so that the pawl *f′* moves the ratchet-wheel G, arbor *h*, and disk L another one-fourth of a revolution, bringing the parts to their original positions, when the same operations will be repeated so long as the battery-current is kept closed.

In changing the direction of the flow of the battery-current it will be seen that the circuit is at no time actually broken, and therefore there is no escape and loss of electricity, and no spark to burn or corrode contact-points, the cores of the magnets being tubular, (or composed of wires, as before stated,) and having a very great extent of surface, and readily magnetized to their maximum power, and as quickly discharged, so that there is no lagging of the armatures either in their forward or retractile strokes, but a prompt and vigorous alternate co-operative movement.

While I have shown the commutator as a double eccentric or oval carbon disk or wheel having carbon rollers in electric contact therewith, I do not limit myself to carbon, as any of the metals or other conductors may be used which will permit of a change from slight to firm contact, and vice versa. Neither do I limit myself to the form of the commutator as shown, as a series of separate cams or eccentric disks may be fixed upon the arbor, with their throws or longest radii arranged to properly alternate the pressure of spring contact plates or rollers; and, if desired, the arbor *h* may carry a circular centrally-mounted disk, and the rollers may be eccentrically mounted on their axes; or a corrugated or compound cam-wheel may be fixed upon arbor *h*, formed to vary its contact-pressure with a series of contact springs or levers in any desired order.

While I have shown but one magnet in each separate circuit, it will be readily understood that as many may be used as desired.

In lieu of the ratchet-wheel, a finely-serrated wheel may be used, and instead of the said

wheel and dogs or pawls the ends of the armature-levers may be connected with arbor *h* by means of cranks or eccentrics and suitable links.

What I claim is—

1. In an electric motor, the combination, with one or more movable armatures, of a movable shaft connected therewith by intermediate devices, one or more electro-magnets arranged to act upon said armature or armatures and provided with cores formed of soft-iron tubes or bundles of soft-iron wires, and a commutator operated by said shaft to cause said magnet or magnets to be alternately charged and discharged by variation of contact between conductors without disconnection of said conductors, substantially as described.

2. A commutator or current-changer in which the electric current is caused to flow from a main conductor to one or another of several branch conductors in contact therewith by increasing the contact-pressure between the said main conductor and the branch conductor over which the current is desired to flow, substantially as described, whereby an actual break of the current is avoided, as and for the purpose set forth.

3. A commutator or current-changer in which a main conductor is formed of carbon and branch conductors are arranged to bear thereupon with varying pressure, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

C. A. RANDALL.

Witnesses:

HENRY HESSE,

P. G. RANDALL.