J. C. LUDWIG.

Electro-Magnetic Motor.

No. 217,807. Patented July 22, 1879.

Fig. 1.

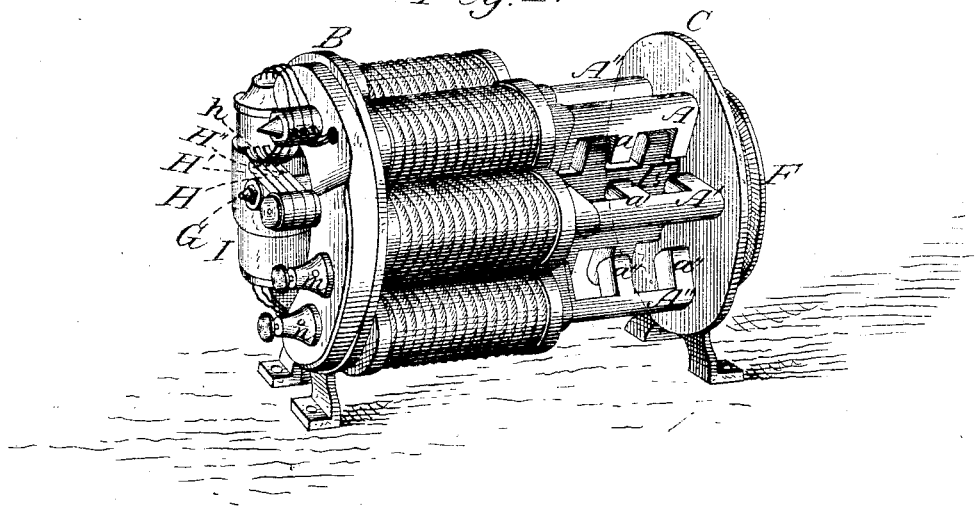


Fig. 2.

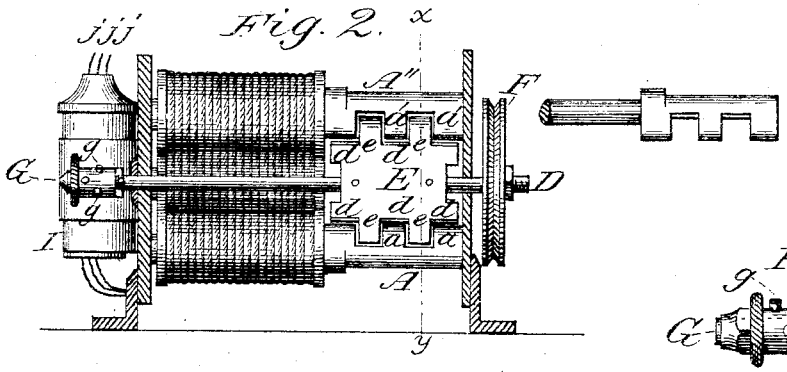


Fig. 5

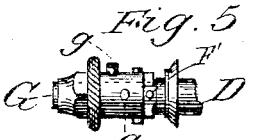


Fig. 3.

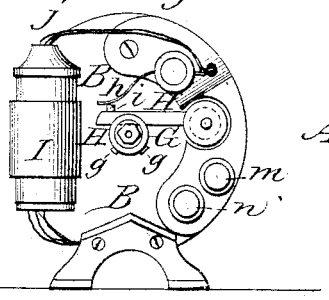
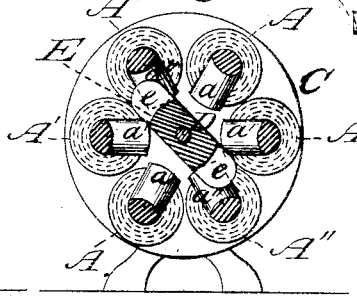


Fig. 4.



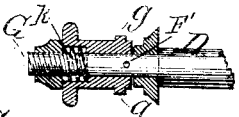


Fig. 6

Attest:

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UNITED STATES PATENT OFFICE.

JOHN C. LUDWIG, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN ELECTRO-MAGNETIC MOTORS.

Specification forming part of Letters Patent No. **217,807**, dated July 22, 1879; application filed July 22, 1878.

To all whom it may concern:

Be it known that I, JOHN C. LUDWIG, of the city and county of San Francisco, in the State of California, have invented a certain new and useful invention or Improvement in Electro-Magnetic Engines, which invention is fully set forth and described in the following specification and the accompanying drawings.

My invention relates to electro-magnetic engines in which the attraction of a set of magnets arranged in a circle about a central shaft carrying a bar or armature is caused to draw the armature continuously forward as the magnets act in rotation, and thus cause the armature and its shaft to revolve, the current being cut off from one magnet as soon as it has attracted the armature, and being applied to the magnet next in advance by suitable automatic mechanism.

The invention consists in the combination of the principal operative parts of my engine, as fully hereinafter explained.

Referring to the accompanying drawings for a clearer description of my invention, Figure 1 is a perspective view of my improved engine. Fig. 2 is a vertical longitudinal section. Figs. 3 and 4 are right and left hand views, respectively, of the ends of the engine, Fig. 4 being taken in section through the line *x y*. Fig. 5 is a detail view of the reversing mechanism, and Fig. 6 a section of the reversing-sleeve and shaft, showing the friction-spring and the stop.

In the drawings, A A′ A″ represent the magnets; B C, the two circular plates between which they are held, and D the central shaft, which carries the armature E.

The magnets are arranged around the center shaft in a circle, with one limb of each magnet diametrically opposite to its other limb, and this shaft has a pulley, F, by which the revolutions of the shaft and armature are transmitted to the machinery to be driven.

In the construction of these magnets and their armature I increase the surface of attraction by making the poles of each magnet somewhat longer and with a projecting tooth or member, *a a′*, &c., that coincides with a slot or recess, *d d*, in the ends of the armature, the width of the armature being increased in a corresponding manner, and teeth or projections *e e* being formed upon each side of the recess *d*, which are of proper length to play between the projections *a a′ a″* of the magnets. Thus the magnets and the revolving armature E are given an increased surface, and better results are obtained from the same power of battery used, as it will be seen from Fig. 2 of the drawings that more surface is had by constructing the parts A A′, &c., and E with alternate teeth and slots or recesses than if a plain surface were employed.

The cut-off mechanism consists of the sleeve G, with its pins *g g g* and the levers H H′ H″, as illustrated in Figs. 1, 3, 5, and 6 of the drawings, by which the current is directed to and cut off from each magnet in succession. This sleeve I construct to turn loosely upon the end of the shaft D, but cause it also to be carried around with the latter by means of the groove in the sleeve and the stop F′ on the shaft, so that the sleeve can be turned upon the shaft in either direction for a distance equal to the space between any two of the pins *g*. By this means I provide a simple and instantly-operating reversing mechanism for changing the direction of rotation of the armature-shaft D.

The levers H H′ H″, that rest upon the sleeve G, are thrown up in contact with the springs *h* by the action of the pins *g g*, &c., and from the position of these pins the levers are lifted in regular order one after the other, and as any one is brought in contact with its spring *h* above it the others are dropped out of contact, and the current is cut off from all but the one magnet that is attracting until the armature has reached the point of greatest attraction between the projections *a a′*, &c., when the next lever H is lifted and the current completed through the next magnet in the order as it is cut off from the last one in action.

The sleeve G is caused to turn with the shaft D by means of the friction produced by a spring, *k*, fitted within it and around the shaft, and yet it is sufficiently free to be turned either backward or forward, as it is desired to change the direction of the engine, for it will be seen and understood from the arrangement of these parts, as shown in the drawings, that by turning the sleeve back upon the shaft at

any time in the operation of the machine the pin *g* last in contact with its lever will be turned back in contact with it again, and thus the current will be completed again through the last-acting magnet, and the armature E, instead of being attracted by the next magnet forward, will be brought back again by the action of the last magnet, and a reverse motion will take place. Thus by turning the sleeve G back upon its shaft at any time the direction of rotation of the shaft D will be changed.

In connection with the cut-off levers H H′, &c., and their springs *h h*, &c., I employ a resistance-coil, I, for leading the current more quickly away from the last-acting magnet, and thus prevent the magnets in the series from becoming permanently magnetized. The action of this coil I draws off the current directly from the springs instead of allowing it to pass over to the levers H, and by providing this conducting-off coil the result is to more quickly demagnetize the magnet last in operation, besides protecting the parts from the sparks that are produced when the current is allowed to pass from the springs to the levers H.

The coil I is formed of the wires *j j j*, led from each spring *h*, and wound either together in one bobbin or in separate bobbins, and connection with the plate B of the engine, to which the magnets A are fixed, is made from the end of the coil, so that the current drawn off by this resistance-coil is carried off through the post *n*, and this excess of electricity is led off from the points *i i* through the coil without acting to burn off the points and without interfering with the full effect of the battery.

The receiving-post *m* is connected with the lower arms of the three magnets A A′ A″, and is insulated from the plate B, while the upper arms of the magnets are connected with the springs *h* and with the resistance-coil I. The coil I is connected with the metal plate B, and so is the post *n*, which holds the wire for conducting off the electricity.

In the operation of the engine there is a continuous current from the wire held by the post *m* through the magnet in the direct circuit, through the spring *h* in contact with one of the levers H H′ H″, through the plate B, and off at the post *n*, while the magnet previously in the direct circuit has its electricity conducted off by a much longer course through the resistance-coil I, the plate B, and post *n*.

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

In an electro-magnetic engine, the combination of the double-limbed magnets having their poles provided with recesses and projections, the double armature having corresponding recesses and projections, the loose sleeve on the armature-shaft provided with pins and connected with the magnets through levers and springs, forming a cutting-off and reversing mechanism, and the resistance coil connected with the magnets, the parts being arranged to operate substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal this 15th day of June, 1878.

JOHN C. LUDWIG. [L. S.]

Witnesses:

EDWARD C. OSBORN,

C. W. M. SMITH.