W. E. SAWYER.

ELECTRO-MAGNETIC ENGINE.

No. 191,781. Patented June 12, 1877.

Fig. 1.

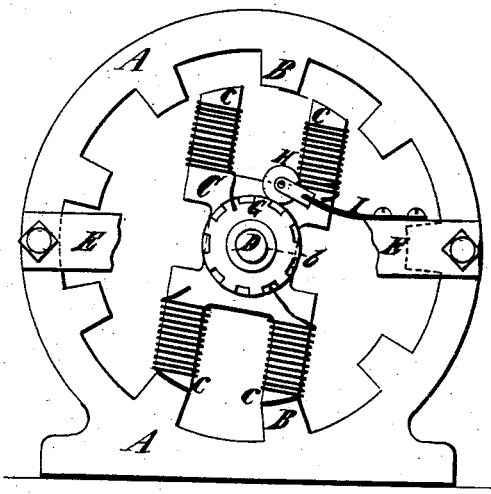


Fig. 2.

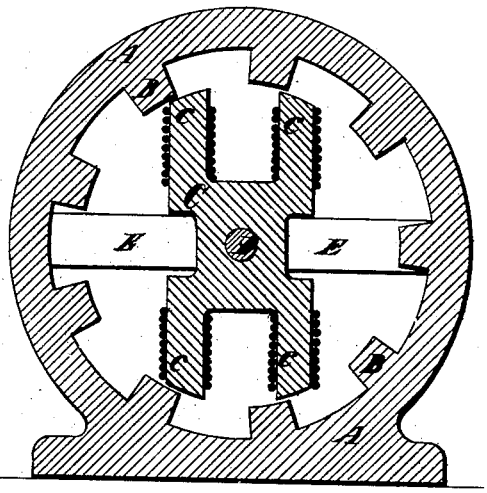
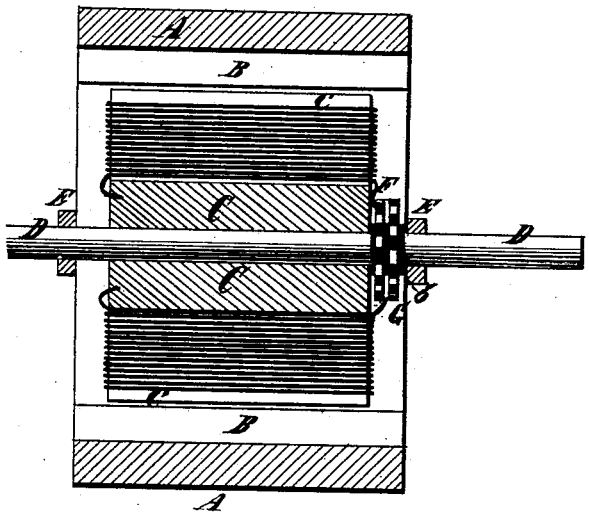


Fig. 3



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UNITED STATES PATENT OFFICE.

WILLIAM E. SAWYER, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRO-MAGNETIC ENGINES.

Specification forming part of Letters Patent No. **191,781**, dated June 12, 1877; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, WILLIAM EDWARD SAWYER, of the city, county, and State of New York, have invented certain new and useful Improvements in Electro-Magnetic Engines, of which the following is a full, clear, and exact description.

My improvement relates to an arrangement of the electro-magnets in relation to their armatures, whereby short, but extremely powerful, electro-magnets are caused, through the close proximity of their poles, to act in an intense magnetic field upon relatively short armatures, which, passing before the poles of the magnets in the line of an arc extending from pole to pole of the same, present a constant succession of homogeneous armatures without intervals of separation between any two consecutive armatures; and in the construction of an iron drum, having numerous projections upon its inner periphery, any two of which, together with the portion of the drum intervening between them, form an armature for the magnets; and in the combination of a drum having projections with a magnet or magnets, the distance between whose poles is the distance between any two of the projections on the drum.

In the drawings accompanying and forming a part of this specification, Figures 1 and 2 are end views, and Fig. 3 is a sectional top view, of the motor.

A is a cast-iron drum or barrel, having a foot-piece to hold it in position when the drum is stationary, as is the case in the form shown.

When it is desired to revolve the drum, the foot-piece is omitted, the shaft D of the magnets then being stationary.

Upon the inner periphery of the drum are nine projections, B, each one running longitudinally through the drum, although any number of these projections may be employed.

I prefer to cast the drum and projections in a single piece.

Malleable-iron castings, or castings of the iron employed in the production of Bessemer steel when it has arrived at that point at and before which carbon is added to the molten mass, best answer the purpose; but ordinary cast-iron may be employed. I may, however, employ wrought-iron in the construction of the drum, which may be made in sections, the preference being given to the solid mass.

The limbs of the two magnets *c c c c* I prefer, as shown, to be welded to back piece C; but I may construct them of plates of iron bolted to the back-piece.

To increase the magnetic effect, each limb may consist of several thin plates of iron, bolted together and to the back-piece.

The magnets may be cast of the malleable or the Bessemer iron, as hereinbefore mentioned, any tendency to polarization being corrected by occasional or alternate reversals of the battery-current in the helices of the magnets by means of a commutator or otherwise; but I greatly prefer to construct them of wrought-iron.

In very large motors it may be inconvenient or impossible to employ a single back-piece for two magnets, in which case the back-pieces of each magnet may be bolted to or form a part of the exterior periphery of an iron drum; or they may be bolted to flanges fixed to the shaft.

Through the back-piece C of the two magnets runs the shaft D, having its bearings in the cross-pieces E, which are bolted to opposite sides of the drum. The interior of the drum is bored out, so that the faces of the projections B form segments of a true circle. The pole ends of the magnets are also turned off, so that their faces form segments of a true circle slightly less in diameter than that of the faces of the projections B.

The magnets are alternately charged with electricity. When one is charged, the magnetic circuit is formed from one of its poles through a projection, B, and thence through the circumferential mass of the drum to the next projection B and the other pole of the magnet. The magnet is thus drawn up to and opposite two of the projections B, as shown in Fig. 1. Each pole of the magnet on the opposite side of the shaft is then directly between two of the projections B. The current of electricity is removed from the first magnet and put into the second, when the motion of revolution carries the second magnet a little over the center of the distance between two projections, and the action recorded in the first instance is repeated, the current in the second

magnet being removed so soon as it arrives opposite its two projections, B, and restored to the first, and so on indefinitely, whereby continuous rotary motion of the magnets and their shaft is maintained. It is thus apparent that any two of the projections B, together with that portion of the drum which is between them, constitute an armature for the magnets. It is also apparent, first, that the projections B may be brought very near together, forming very short armatures; second, that in the construction of electro-magnets shown it is possible to bring their poles very close together, with the same quantity of wire in the helices that, if wound upon a cylinder of iron containing the same mass of metal, as in ordinary magnets, would greatly separate the poles; third, that the closer the poles of the magnets to each other the more powerful is the action upon their armature; fourth, that the shorter the magnets the quicker and the more intense their action; and, fifth, that, as I combine with a short armature of considerable mass a short magnet whose poles are very close together, I obtain greater power, greater intensity of action, and greater speed of charge and discharge of the magnet than have heretofore been accomplished in electro-magnetic engines.

To charge the magnets properly, I employ a commutator, F G, constructed as follows: Two metal disks are cut with as many teeth as there are projections on the drum. I prefer that the space between two teeth shall be equal to the face of each tooth; but the space may be slightly in excess. These disks, slightly separated, are fixed to an insulating-hub, *b*, so that the teeth on one disk come opposite the spaces on the other. The teeth of the two disks F and G are indicated by the white divisions, Fig. 3. The spaces between the teeth may be filled in with an insulating substance, if desired.

To these disks, thus insulated from each other and from the shaft D, are connected the helices of the magnets, as follows: One end of the wire composing the helices of the lower magnet, Fig. 1, is connected to the shaft or metal of the magnet; the other end of the wire is connected to the disk G. One end of the wire composing the helices of the upper magnet is in like manner connected to the shaft or metal of the magnet, the other end of the wire being connected to the disk F. A metal roller H, wide enough to overlap the distance between the two disks, is held to a bearing upon the disks by an insulated spring, I, or equivalent device. One pole of the battery (not shown) is connected to the shaft D through the drum and cross-piece E, the other pole being connected to the spring I.

It is obvious that as the roller H bears upon a tooth of disk G the lower magnet is charged by the battery; but as it leaves that tooth the battery is removed from the lower magnet, and, by the bearing of the roller upon the succeeding tooth of disk F, it is directed through the helices of the upper magnet. To guard against accidents, which might result from carelessness while the magnets are swinging round, the ends of the drum may be entirely covered with wood or metal, leaving only the ends of shaft D exposed.

By moving the spring I backward or forward, thus changing the position of the roller H upon the disks F G, not only may the speed of revolution be regulated, but the direction of revolution may be reversed; and where it is desired to so regulate or reverse, the spring may be attached to any convenient form of lever workable by hand or foot.

In applying my engine to the running of machinery, I transfer its power by crank, pulley, or gearing attached to the motor-shaft.

In engines constructed upon the principle of my invention it is possible to obtain very considerable powers with comparative economy of construction and operation. In all other forms of electro-motors it has been necessary, in order to obtain considerable powers, either to employ a great number of small magnets, rendering the machinery very costly, or to employ long and large magnets, which, besides requiring extremely powerful batteries in their operation, charge and discharge too slowly for almost any practical purpose. In my invention, however powerful the engine is designed to be, short magnets are retained, their power being increased not by lengthening the mass of iron forming the connection from pole to pole, but in transversely lengthening the plates composing the limbs of the magnets. Thus the charging and discharging of the limbs of large magnets is effected as rapidly as the charging and discharging of limbs of less transverse length, provided that the limbs in both cases shall be of the same thickness and the same length from pole to pole. Increase of power is thus obtained without loss in speed.

The drum may be of any diameter, and, within reasonable bounds, of any length.

Although in small power motors, for economical reasons, I employ but two magnets, where greater powers are required a greater number of magnets is necessitated, and these are arranged one to follow another. I do not, therefore, limit myself in the number of the magnets, or the diameter or length of the drum.

It is obvious that the drum, instead of the magnets, may be revolved, the drum then forming a pulley; or that the projections forming the armatures may be upon the exterior periphery of the drum, and the magnets outside the drum, instead of as shown in the drawings, the form shown being preferable on account of its compactness, ease of moving, transportation, &c.

It is further obvious that the electro-magnetic engine of my invention is applicable to all kinds of machinery requiring for its operation a power within its scope. In applying it to sewing-machines, I combine with it a friction-clutch, worked by the foot of the oper-

ator, for the purposes of controlling and regulating speed.

For pumping purposes, I fix to the motor-shaft a pinion meshing into a gear from which the pump is worked, whereby a slow and powerful motion of the plunger is obtained.

For the propelling of boats, I either continue the motor-shaft to the propeller, or gear from the motor to the propeller-shaft.

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

1. In an electro-magnetic engine, a fixed or revolving drum, provided with projections circumferentially equidistant, any adjoining two of which, together with that portion of the circumferential mass of the drum which is between such two projections, forms the armature of an electro-magnet, substantially as shown and described.

2. In an electro-magnetic engine, the combination, with an electro-magnet whose poles consist of elongated edges running parallel to each other, of an armature whose ends consist of elongated projections running parallel to each other, and also to the elongated poles of the magnet, the distance between the projections of the armature being the distance between the poles of the magnet, as and for the purpose specified.

3. In an electro-magnetic engine, the arrangement of an electro-magnet with relation to a drum or barrel provided with circumferentially-equidistant projections, any adjoining two of which, together with the circumferential mass of iron between them, constitute an armature, whereby the action of the magnet is such as to cause one of its poles to precede the other in the direction of its revolution, substantially as shown and described.

WILLIAM EDWARD SAWYER.

Witnesses:

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