(No Model.)

A. MILLAR.

MAGNETO ELECTRIC MACHINE.

No. 270,457. Patented Jan. 9, 1883.

FIG.6.

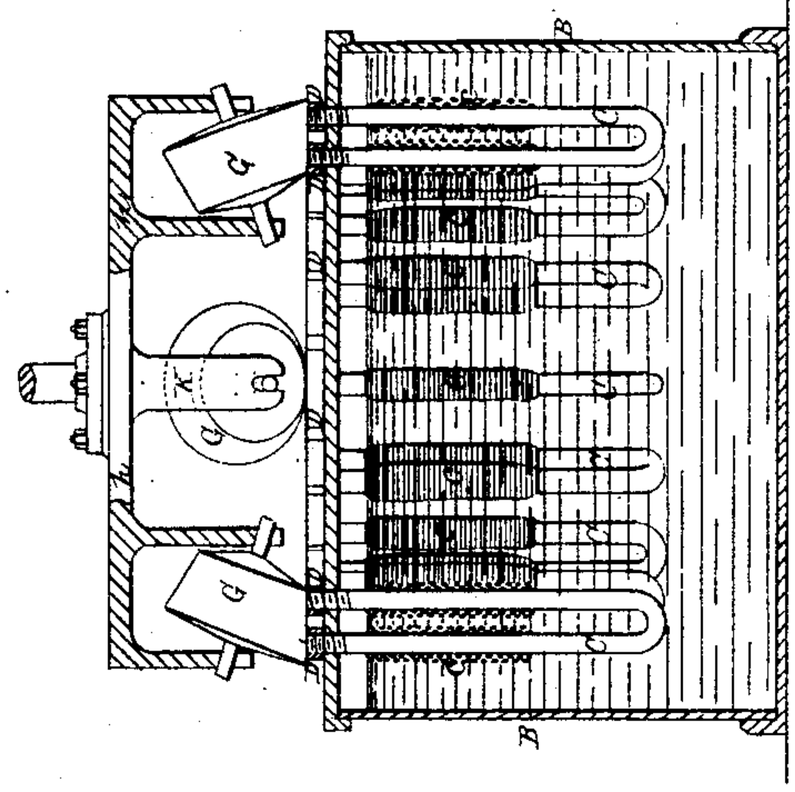


FIG.5.

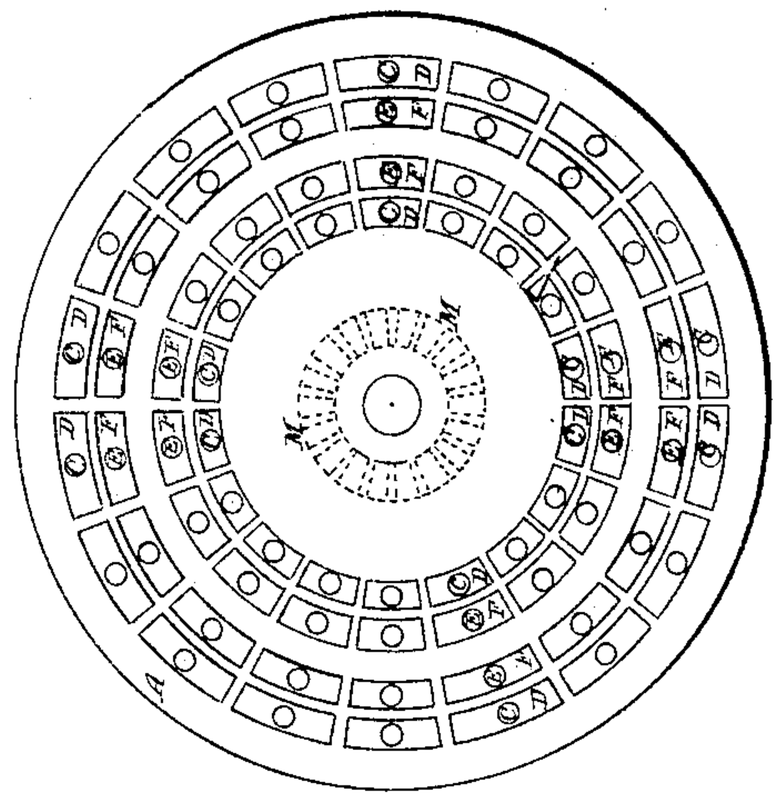


FIG.3.

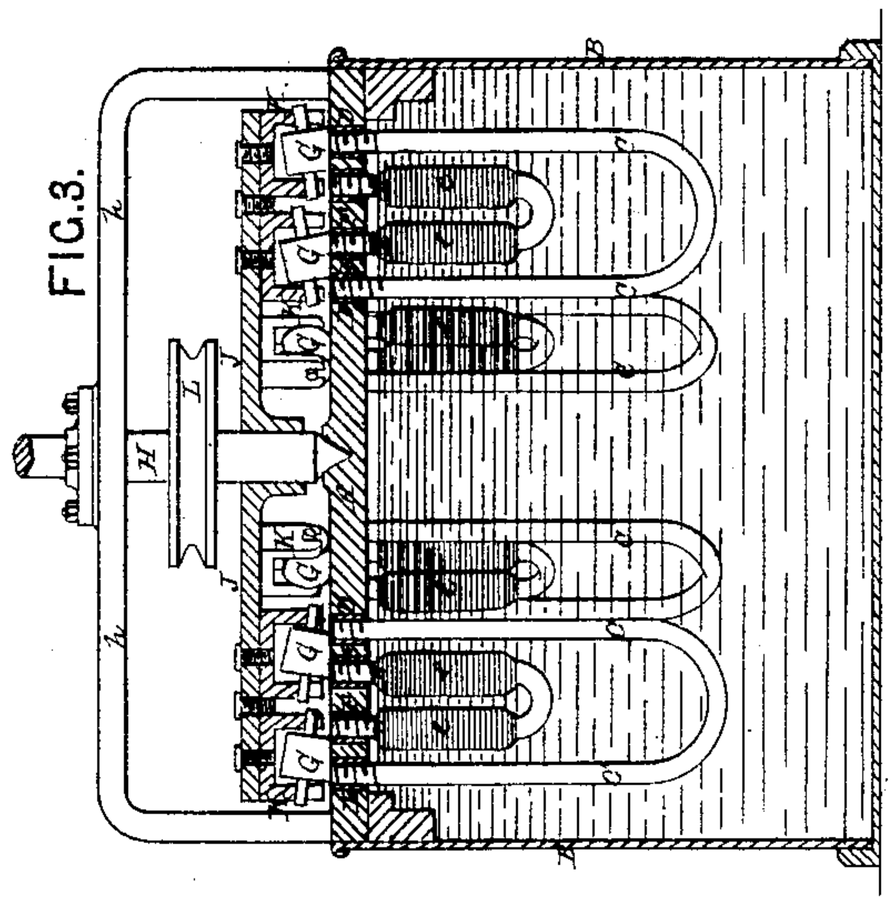


FIG.4.

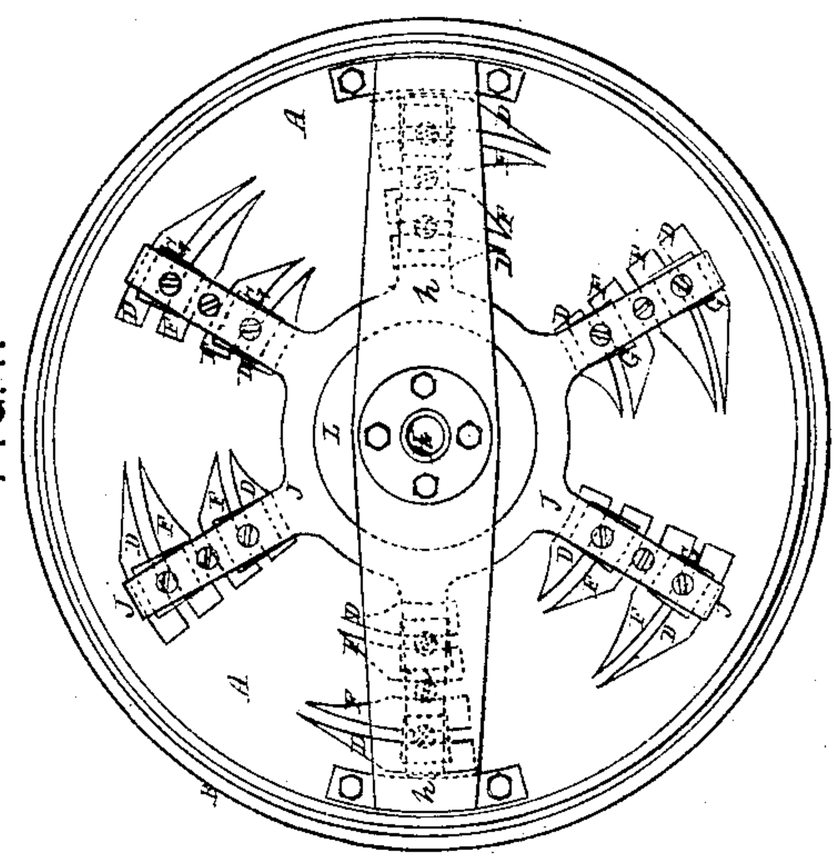


FIG.1.

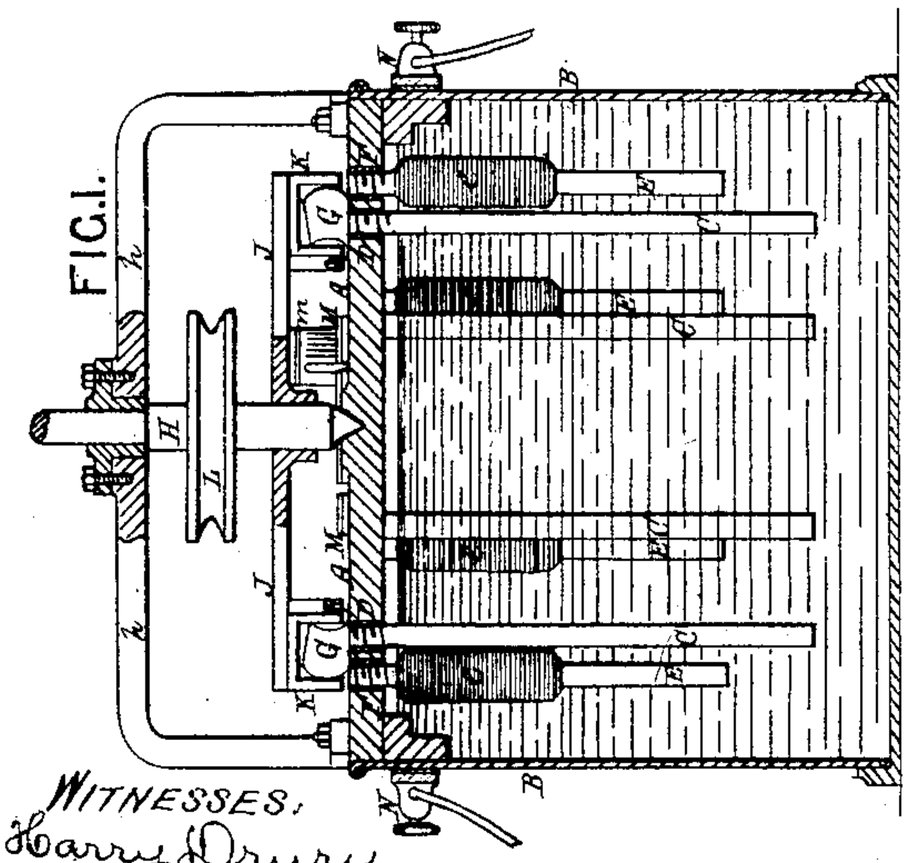
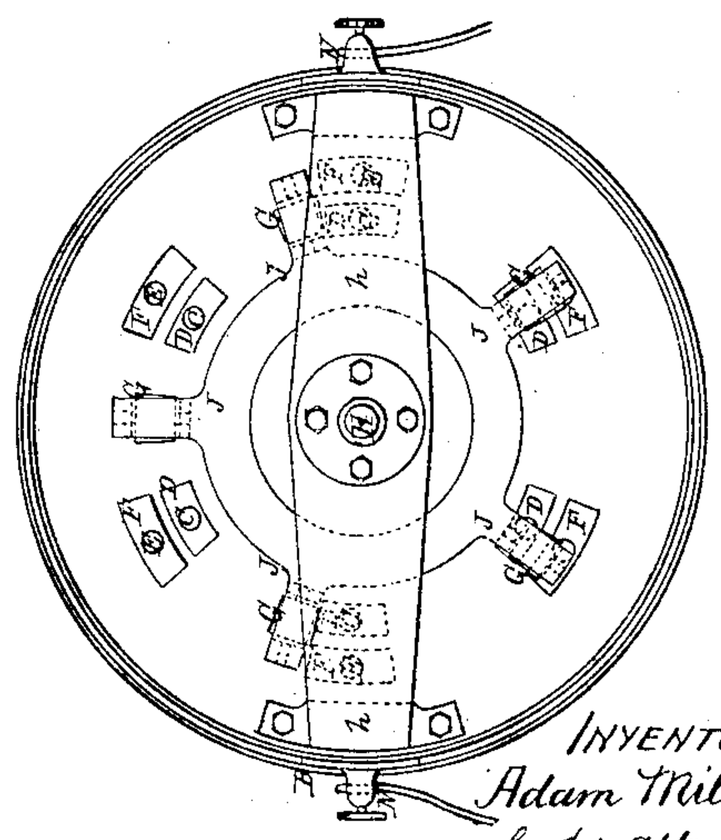


FIG.2.



WITNESSES:
Harry Drury
Hamilton D. Turner

INVENTOR:
Adam Miller
by his Attorneys
Howson and Sons

UNITED STATES PATENT OFFICE.

ADAM MILLAR, OF GLASGOW, SCOTLAND.

MAGNETO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 270,457, dated January 9, 1883.

Application filed July 3, 1882. (No model.) Patented in England October 20, 1881, No. 4,592.

To all whom it may concern:

Be it known that I, ADAM MILLAR, of Glasgow, Scotland, have invented certain Improvements in Apparatus for Generating Electric Currents, of which the following is a specification.

This invention relates to improvements in magneto-electric machines, and comprises an improved construction or arrangement and combination of the parts of a magneto-electric machine, which consists of a disk or circular plate of bronze or other non-magnetic metal resting on the sides of a cylindrical tank or cistern. A series of six or other number of permanent magnets is arranged in a circle concentric with the disk, having their poles terminating in pieces of soft iron, which are inserted into the disk and having their upper surfaces level with the upper surface of the disk. A series of six or other equal corresponding number of soft-iron bars is arranged in a second circle exterior to and concentric with the circle of permanent magnets. Each soft-iron bar is surrounded by a coil of insulated copper wire, which forms part of a closed circuit. These soft-iron bars terminate in pieces similar to the terminal pieces of the permanent magnets, and both sets of soft-iron terminal pieces are shaped so as to form segments of the circle in which they are placed. A series of soft-iron rollers, in number one less than the corresponding number of either series of magnets, rest on the surface of the disk, and are made to traverse a circular path on the surface of the disk by the rotation of an axis carrying the arms, which have forked pieces in which the trunnions of the rollers rotate. The length of the rollers is considerably greater than the space which separates the two circles of segments, so that they roll upon and form connecting-bars to each pair of segments as they pass over them. The axis of the arms carrying the rollers works between suitable bearings and carries a pulley, to which rotary motion is given by a belt driven by a steam-engine or other motor.

The action of the machine is as follows: The magnetism of the primary magnets is communicated to the cores of the secondary or electro magnets by the contact of the soft-iron rollers as they pass across the segmental terminal pieces on the disk during the rotation of the carrying-arms. Currents of electricity are produced in the coils of the electro-magnets at the instant of magnetization and of demagnetization, and these currents are collected by any suitable arrangement of commutators of the ordinary kind. As the magnetization produced by the contact of the soft-iron rollers with the primary magnets and the cores of the secondary magnets is of much greater intensity than would be the case if the magnets were merely made to approach each other without touching, the currents produced in the coils of the secondary currents are also of great intensity.

As the attractive force of the magnets acting upon the soft-iron rollers is very considerable at the moment when the rollers are just leaving the segments, the following arrangements are adopted, either separately or in combination, to enable this attractive force to be overcome and allow the arms carrying the contact-rollers to be rotated by a comparatively small expenditure of power:

First. By making the space or distance which separates the rollers from each other different from the space or distance which separates the segmental pieces, so that only a few of the rollers shall be on the point of leaving segments at the same instant of time. In an arrangement of the machine in which there is a series of six primary and six secondary magnets, and the space between the segmental pieces is the sixth part of the circle, while the space separating the rollers from each other is the fifth part of the circle, in each case measuring from center to center, only one roller is at the point of leaving a segmental piece at the same instant of time.

Second. By altering the shape of the soft-iron contact-pieces so that the parts which first make contact with the rollers may be of a segmental shape, as before; but the remaining parts may be made to be gradually brought to a point at a considerable distance from the limb of the magnet in the one circle and a considerable distance from the core of the electro-magnets in the other circle. The attractive force acting at the points is greatly reduced in comparison to the attractive force developed in the arrangement of segmental contact-

pieces first described, and the force required to move the rollers at the instant of leaving the points is reduced in proportion. This method, however, will greatly reduce the strength of the currents which arise during the demagnetization of the soft-iron cores, as by this arrangement the demagnetization is comparatively gradual, and not instantaneous.

Third. By arranging the segmental pieces of soft iron very close to each other, so that a very small space separates them in comparison with the diameter of the soft-iron rollers. This arrangement allows the magnetization of the secondary or electro magnets to be maintained at a high degree of intensity up to the instant of demagnetization, while the force required to move the rollers from off one segment onto the next one is comparatively slight.

In order that the several improvements may be more easily understood, the primary and secondary magnets have been referred to as magnets acting by one pole only; but it is not intended that the improvements should be confined to magnets of that form.

The improvements are also applicable to what are commonly called "horseshoe" magnets, in which both poles operate equally. When the primary and secondary magnets are of the horseshoe form the magnetization of the secondary magnets is effected by the contact of two separate rollers, each roller making contact with one pole of the primary magnet and one pole of the secondary magnet. Both rollers are by preference driven by the same arm and move simultaneously. Also, the primary magnets have been assumed to be permanent steel magnets; but the improvements are equally applicable to electro-magnets magnetized by currents of electricity obtained from a source outside of or separate from the machine now described, acting alone or in combination with currents produced by the secondary magnets of the machine.

In order that the heat which is developed during the working of such magneto-electric machines when driven at a high speed may not interfere with the efficiency of the machine by reducing the conductivity of the wires forming the coils, I fill the tank or cistern on which the disk rests with water or other heat-absorbing liquid, so that the cores and coils of the electro-magnets are immersed in and surrounded by the water or other liquid, thereby keeping the coils from becoming heated to any considerable degree; and if the heat-absorbing liquid be a non-conductor—as, for example, paraffine-oil—the wires of the coils may be insulated with a covering of cotton or of silk in the usual manner; but if the heat-absorbing liquid be a conductor of electricity—such as water—then in order that the water or other liquid may not be in contact with the wires of the coils, and so lessen the insulation of the wires, I make the coils of wire water-proof in addition to being insulated. For instance, wires are first covered with cotton or silk threads, and are secondly coated with wax, paraffine, or other water-proof and non-conducting material applied to the silk or cotton covering.

In the accompanying drawings, Figure 1 shows a sectional elevation, and Fig. 2 a corresponding plan, of a machine for producing electric currents, constructed in accordance with my invention.

A is a plate of bronze resting on the edges of an open cistern or tank, B, filled with water.

C C C are a set of permanent magnets, attached to the segmental pieces of soft iron D D D. E E E are soft-iron bars, connected to the segmental pieces of soft iron F F F. Both series of segmental pieces D and F are ranged in equal numbers and in the same radial lines in a circle, having their upper surfaces level with the upper surface of the plate A.

A series of rollers, G G G, of soft iron, are traversed in a circular path in either direction on the surface of the disk A, and come into contact with the segments D F simultaneously, the length of the rollers being somewhat greater than the space which separates the two series of segments. The traveling motion of the rollers is obtained by a band from a steam-engine or other prime mover acting on the pulley L, keyed onto the shaft H, working in suitable bearings in the plate A and bracket *h*. The shaft also carries the arms J J, terminating in the forked pieces K K, in which the trunnions of the rollers G rotate. The shaft H is concentric with the circles of the segments and perpendicular to the surface of the disk A. The soft-iron bars E E E are each surrounded at the end nearest the segments by a coil of insulated copper wire, which forms part of a closed circuit. When the shaft H is made to rotate in either direction the magnetism of the magnets is communicated to the soft-iron bars E E E by the rollers G G G making contact with the segments D and F; and currents of electricity are produced at the instant of magnetization and again at the instant of demagnetization, when the rollers move off the segments. The currents are collected by a suitable arrangement of commutators, M, and brushes *m*, as indicated in the central part of the disk A, which communicate with the terminals. The heat which is produced in the coils of wire is absorbed by the water or other liquid in the tank as fast as it is produced, so that the wires remain at a comparatively low temperature, even when generating currents of electricity sufficient to cause a considerable amount of heat, while the contact-making devices and other moving parts of the machine are free from the water, and their motion not impeded thereby.

In the arrangement shown in Figs. 1 and 2, five arms J, fitted with rollers G, are caused to traverse over six sets of permanent and electro magnets C E; but any other corresponding numbers may be used—such as, for example, eleven revolving arms and twelve sets of magnets.

Figs. 3 and 4 show a sectional elevation and plan, respectively, of one modification of the machine in which the primary magnets C are made of a horseshoe shape and the secondary magnets E, of soft iron, also of horseshoe shape, so as to utilize both poles of the magnets, each pole of the magnets being surrounded by coils of insulated wire. The segmental pieces D and F in this arrangement are made so as to be gradually tapered to a point at one end, so that the attractive force acting on the rollers will be gradually lessened as the rollers traverse them, and allow the rollers to be moved off the segmental pieces with a comparatively small expenditure of power. This arrangement, however, will reduce the strength of the current which arises when the rollers leave the pieces. The direction of motion of the series of rollers G is indicated by the arrows on Fig. 4. The revolving arms and rollers correspond in number to the sets of magnets and segmental peices D F.

Fig. 5 is a plan of the plate A and segmental pieces D F, showing another arrangement for lessening the attractive force of the magnets upon the rollers. The magnets are increased in number so that the ends of the segmental pieces D D and F F are very near to each other, and the rollers G G roll in either direction from off the one onto the other with comparatively little expenditure of power. The commutators are indicated by the radial plates M.

It is to be understood that instead of the permanent steel magnets C, mentioned as the "primary" magnets, electro-magnets may be used, their magnetism being produced by electric currents obtained from galvanic batteries or other sources of electricity.

Fig. 6 is a vertical section, showing an arrangement in which the electro-magnet form of armature is dispensed with, and the electric currents are produced in coils of insulated wire *c*, surrounding each of the two limbs of the primary magnets C. The poles D of the magnets C are made close together, and the iron roller G alone forms the armature. Electric currents are produced in the coils of wire *c c*, surrounding the limbs of the magnets C C, at the instant when the iron roller G makes simultaneous contact with the poles D of the magnets C, and also at the instant when the roller G ceases to make contact with the poles D.

I claim as my invention—

1. In a magneto-electric machine, the combination of permanent magnets, temporary electro-magnets having coils in the working circuit, and pole-pieces for both magnets, with a rotating contact-maker adapted to simultaneously make contact with the pole-pieces of the permanent and temporary electro-magnets, substantially as and for the purpose set forth.

2. In a magneto-electric machine, the combination of permanent magnets, temporary magnets having coils in the main circuit, and pole-pieces D F, with revolving arms carrying rollers G, adapted to make contact with the said pole-pieces, substantially as described.

3. In a magneto-electric machine, the combination of contact-makers with permanent and temporary magnets having pole-pieces extending from the limbs of the magnets and tapering or gradually reduced in bulk from said limbs, substantially as specified.

4. The combination of the stationary electro-magnets and the moving parts of a magneto-electric machine, with a receptacle containing liquid in which the coils of the field-magnets are directly immersed, while the moving parts are out of contact therewith, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ADAM MILLAR.

Witnesses:

W. R. M. THOMSON,

JOHN SIME,

Both of 96 Buchanan Street, Glasgow.