

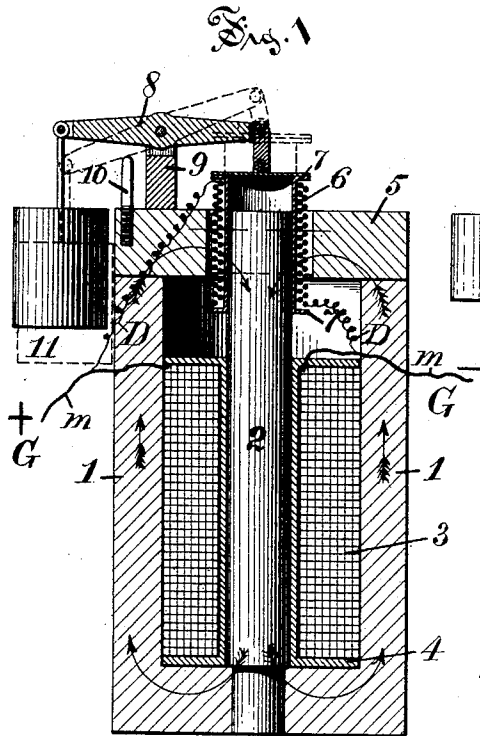
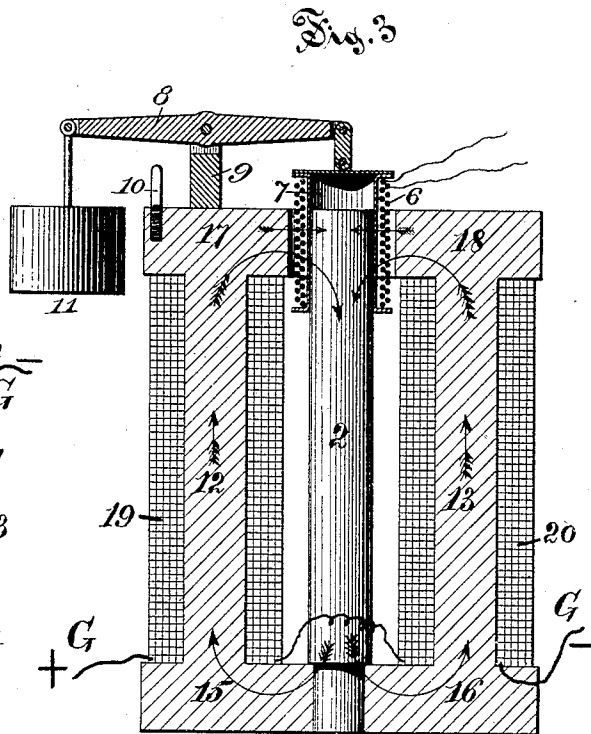
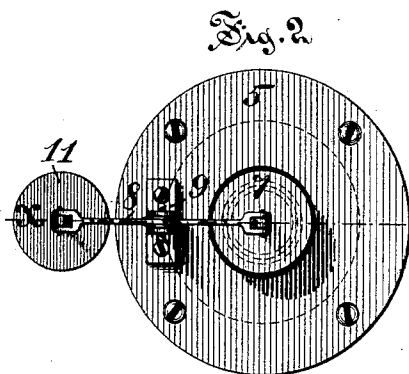
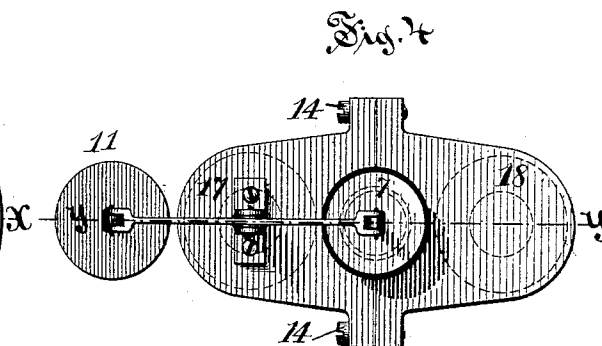
(No Model.)

R. H. MATHER.

ELECTRO MECHANICAL MOVEMENT.

No. 387,310.

Patented Aug. 7, 1888.



Witnesses:

Wm Yorkman.

H. R. Williams.

Inventor:

Richard M. Mather, by

Willard Eddy,
his Attorney.

his Attorney.

UNITED STATES PATENT OFFICE.

RICHARD H. MATHER, OF WINDSOR, CONNECTICUT.

ELECTRO-MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 387,310, dated August 7, 1888.

Application filed January 9, 1888. Serial No. 260,179. (No model.)

To all whom it may concern:

Be it known that I, RICHARD H. MATHER, of Windsor, Hartford county, Connecticut, have invented a new and Improved Electro-Mechanical Movement, which is described in the following specification, and is illustrated by the accompanying drawings.

The invention is an electrical instrument in which an electro-magnet and a solenoid, which serves as an armature of the same, react upon each other to produce a movement of the solenoid. This instrument is designed to possess great strength and sensitiveness and to manifest a long range of movement with uniform power.

The best method in which I have contemplated applying the principle of my invention is shown in Figures 1 and 2, Fig. 1 being a central vertical section of my improved electro-mechanical movement on the line xx of Fig. 2, and the latter being a plan view of the same. Figs. 3 and 4 represent my invention in a modified form, Fig. 3 being a central vertical section on line yy of Fig. 4, and the latter being a plan.

As seen in Figs. 1 and 2, the electro-magnet of this instrument, aside from its solenoid-armature, consists of an external cylindrical iron case, 1, an internal cylindrical core, 2, and an interposed helix of insulated wire, 3. Core 2, having one end driven into a hole in the solid bottom of case 1, makes an ample contact therewith and occupies an axial position through the entire length of that case. This core is formed of the best wrought-iron or other highly-conductive material. In construction, helix 3 is wound upon a hollow spool, 4, of brass or other non-magnetic material, and is then slipped over the free end of core 2 into position within case 1. An annular iron cap, 5, which makes an ample contact with case 1, is then screwed down in the position shown and surrounds the free end of core 2, but is separated therefrom by an annular space. A solenoid, 6, of insulated wire, wound upon an insulating spool, 7, is mounted upon an oscillating lever, 8, in such a manner as to occupy this annular space and to move freely up and down through it. Lever 8 is pivoted in bracket 9, and is limited in its movement by stop 10. Weight 11, which depends

from lever 8, represents the load which the instrument is adapted to carry. The described helices (shown in Fig. 1) may be connected with a battery or other electric generator in any desired manner. For instance, helix 3 may be placed in the main circuit m , between the terminals $+$ and $-$ of a generator, which is indicated by the letter G , and helix 6 may at the same time be located in a derived circuit, d , as illustrated in the same figure.

Core 2, solenoid 6, spool 7, lever 8, bracket 9, stop 10, and weight 11, which have been described in connection with Figs. 1 and 2, are also present in the modification which is shown in Figs. 3 and 4. In this modification duplicate massive iron spools 12 and 13 are clamped together in parallel positions upon opposite sides of core 2 by screws 14, which pass through the enlarged lower heads, 15 and 16, and the enlarged upper heads, 17 and 18, of said spools. The upper heads, 17 and 18, of said spools are separated from the free end of core 2 by a narrow space which is occupied by solenoid and spool 6 and 7. Spools 12 and 13 are respectively wound with duplicate helices 19 and 20. The helices of this apparatus in its described modified form may be connected with a battery or other electric generator in any desired manner. The direction of current through helices 19 and 20, however, should be such as to produce like polarity in the upper heads, 17 and 18, of spools 12 and 13. For example, as illustrated in Fig. 3, helices 19 and 20 may be connected in series between the poles $+$ and $-$ of the indicated generator G , while helix 6 is separately excited.

The maximum efficiency of this apparatus requires that helix 3 or helices 19 and 20, as the case may be, shall be sufficient to generate so much magnetism as to raise core 2 near to the point of magnetic saturation, and also that the greatest practicable current be led through helix 6.

All remaining particulars of construction will sufficiently appear from the drawings and from the mode of operation, which is now to be described.

When current is supplied to helix 6 only or to helix 3 only, the moving parts of the described mechanism occupy the positions which are indicated by the dotted lines in Fig. 1.

When electric current is supplied to helix 3 or to helices 19 and 20, as the case may be, a magnetic field is produced in the described spaces about the free end of core 2. The magnetic current may be assumed to circulate through core 2, case 1, and cap 5 of Fig. 1, and through spools 12 and 13 and core 2 of Fig. 3, in the directions which are indicated by the arrows. Circulating in this manner, the magnetic current or lines of force across the described field pass directly through the interposed coils of solenoid 6. When current is also supplied to helix 6, the latter is drawn or driven through said space or spaces a greater or less distance, according to the current supplied and the resistance encountered or work done by the solenoid. With a normal current and load, the solenoid occupies the position shown in the drawings. If the electric current through all or any of the helices of the instrument be diminished, or if the current through either one of the helices of the instrument be reversed, the solenoid is permitted or forced to retire to the position which is first above indicated, as illustrated in Fig. 1.

The principle which is involved in the described attraction and repulsion of solenoid 6 is the same principle by which a conductor carrying a current and disposed in a magnetic field tends to cut the lines of force of that field by moving across those lines in a direction which is dependent upon the polarity of the field and upon the direction in which the current is carried by that conductor.

In the operation of the described invention those individual coils of solenoid 6 which are at any time within the magnetic field are, for the time being, severally attracted or repelled in accordance with this principle. With a constant field, the number of coils so attracted or repelled is constant; hence the resulting movement of the solenoid is of uniform energy throughout its entire extent. By construction the solenoid is of any desired length; hence the range of movement, being dependent upon the length of the solenoid, may be of any desired extent. Lever 8 therefore oscillates through a long range and with uniform power.

Such being the construction and operation of my invention, I claim—

1. A cylindrical iron case which is wholly closed at the base, a close-fitting annular iron cap by which said case is partly closed at the top, and a magnetizable rod or core which is rigidly inserted in said base and extends axially through said case and through the middle of said cap, in combination with a helix of insulated wire which is inclosed in said case, and a movable spool-shaped solenoid which incloses a variable portion of the free end of said core

and has a constant number of its individual helices within the annular space which is formed between said core and said annular cap, substantially as and for the purpose specified.

2. A cylindrical iron case which is solid at one end and hollow in the middle, an electromagnetic core which is inserted axially in said case, and a helix of insulated wire which is placed upon a spool surrounding said core and surrounded by said case, and an annular iron cap which is fastened upon the other end of said case and is separated from a terminal portion of said core by an annular space, in combination with a movable solenoid surrounding said core and having helices within said annular space, substantially as and for the purpose specified.

3. A cylindrical iron case which is wholly closed at one end, a close-fitting annular cap by which said case is partly closed at the opposite end, and a magnetizable rod or core which extends axially through said core and cap, in combination with a helix of insulated wire which surrounds the body of said core and is contained in said case, and a movable solenoid surrounding a variable portion of the free end of said core, and having a constant number, less than all, of its constituent helices in the narrow space between said cap and core, substantially as and for the purpose specified.

4. A cylindrical iron case which is closed at one end, an annular cap by which said case is partly closed at the other end, and a magnetizable core which is inserted in the bottom of said case and extends axially through said case and cap, in combination with a helix of insulated wire which surrounds a portion of said core and is contained in said case, and a movable solenoid surrounding a terminal portion of said core, and constantly occupying the entire length of the annular space which separates said core and cap, substantially as and for the purpose specified.

5. A cylindrical iron case which is hollow in the middle, a magnetizable core which extends from end to end axially through said case, and an annular iron cap which is fastened upon one end of said case and surrounds the adjacent end of said core, in combination with a stationary helix which surrounds said core, and a movable solenoid which surrounds said core and is surrounded by said cap, substantially as and for the purpose specified.

In testimony whereof I hereunto set my name in the presence of two witnesses.

RICHARD H. MATHER.

Witnesses:

HARRY R. WILLIAMS,
WILLARD EDDY.