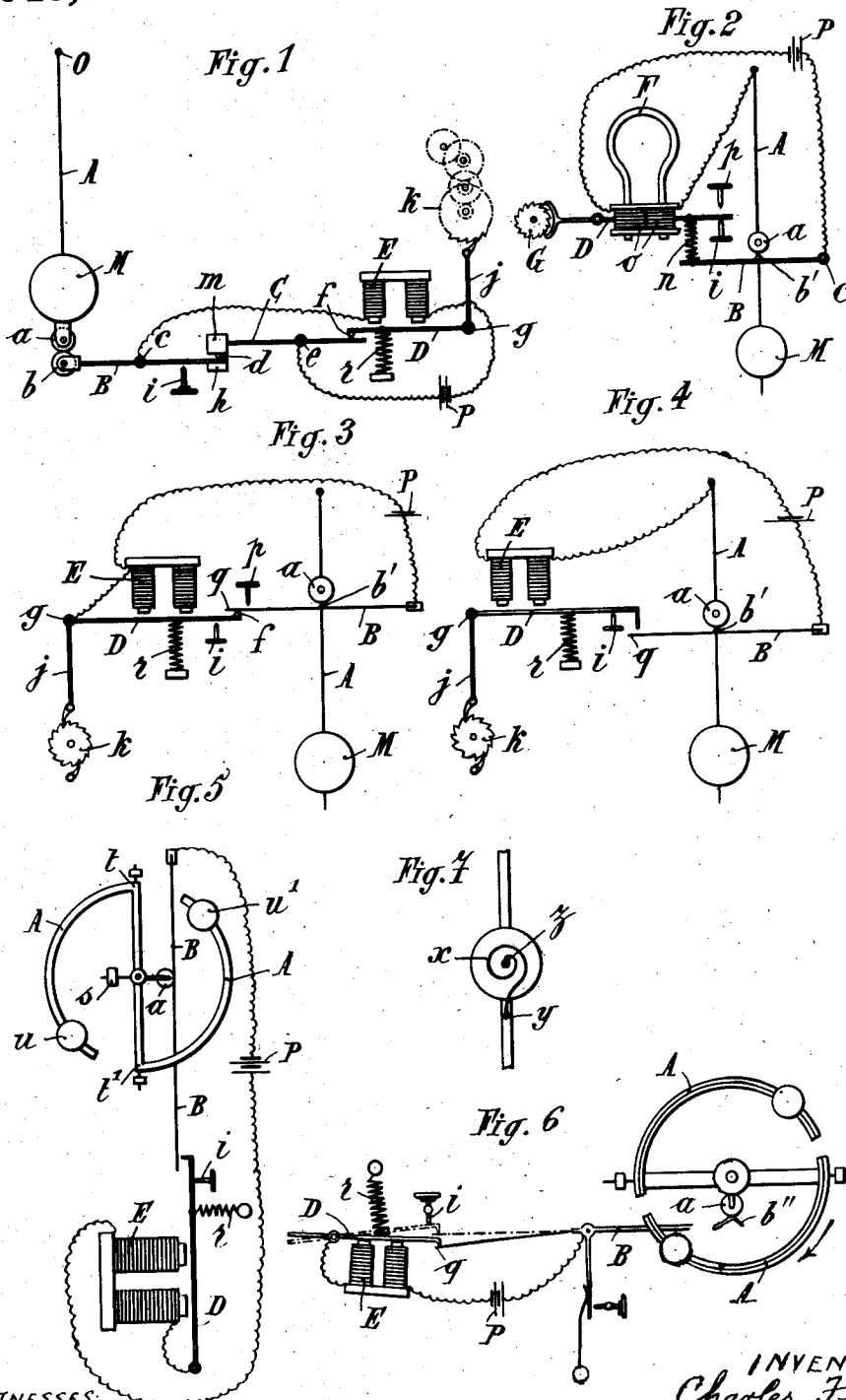


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ELECTRIC CLOCK.
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UNITED STATES PATENT OFFICE.

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ELECTRIC CLOCK.

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To all whom it may concern:

Be it known that I, CHARLES FÉRY, a citizen of the Republic of France, and residing at Paris, France, have invented certain new and useful Improvements in Electric Clocks, of which the following is a specification.

The present invention relates to clocks and the like and particularly to clocks deriving their motive power from electrical or electro-magnetic energy.

It has been shown that in the case of the balance wheel of a watch, as well as in the case of the pendulum, the impulse should be given to the regulating system at the dead point (the vertical position of the pendulum) if it is desired to avoid disturbing the system. This condition is very difficult to realize for a pendulum controlling the hands, particularly if it is desired to eliminate variations of tension of the driving spring or of the voltage of the battery which actuates the clock.

The present invention therefore aims to provide a device for realizing the two following conditions:—1. Imparting energy to the oscillating pendulum in the immediate neighborhood of its vertical position; 2. A constant impulse imparted to the pendulum by a battery so long as its voltage does not fall below a certain limit at which the clock stops.

Figure 1 shows a pendulum provided with a roller for controlling the electric circuit by contacting with a roller at the end of a lever arm; Fig. 2 shows the lever roller replaced by a projection; Figs. 3 and 4 show modifications of Fig. 1; Figs. 5 and 6 show the pendulum replaced by a balance wheel, and Fig. 7 is a modified form of suspending the oscillatory member.

Examples of the invention are shown in the accompanying drawings in which the several figures represent diagrammatically different constructions according to the invention.

In Fig. 1 the pendulum A suspended at O has below its bob M a small roller *a* which, when the pendulum is passing its vertical position bears against a roller *b* fixed at one end of the lever B centered at *c*. This lever is adapted to close the circuit of a battery P by bearing lightly on a contact *d* carried by a lever C centered at *e*. In the position shown, the lever C, which carries a small weight *m* at one end, is held in position by the end *f* of the armature D

of an electromagnet E. When current flows from the battery P through the magnet E the latter attracts its armature D which is pivoted at *g* and the weight *m* on the lever C is free to descend on the corresponding end of the lever B.

When the pendulum has slightly passed its vertical position, the roller *b* bears upwardly on the roller *a* giving rise to a tangential component which tends to push the pendulum toward the outer limit of its oscillation and in the direction in which it is moving, thus giving it a tangential impulse. This effect ceases when the lever C abuts against the end *f* of the armature D, breaking contact between lever B and contact *d*, lever B having a slight further movement. For this purpose the lever B carries at the end on which the weight *m* bears, a small weight *h* slightly heavier than the roller *b* so that it continues its movement until it is brought to rest on the stop *i*. At this moment the pendulum is completely free of the roller *b* and continues its movement after having received an amount of energy represented by the fall of the weight *m* through a limited height, the weight *m* being restored to its normal position by the spring *r* of the armature D. The same events occur as the pendulum returns through its vertical position, so that the pendulum receives an impulse at each half oscillation without suffering any ineffective blow.

The half oscillations of the pendulum may be integrated in the ordinary manner by the wheel *k* which is driven by a pawl carried by a rod *j* connected with the armature D.

Instead of the electromagnet E, there may be used a polarized electromagnet, a coil suffering displacement in a magnetic field, an iron core or a magnet attracted by a solenoid or any other equivalent device.

Fig. 2 shows a modification in which the small roller *a* presses in the vertical position of the pendulum a finger *b'* carried by the lever B pivoted at *c* and thus brings through the intermediary of a spring *n* the lever D on to the stop *i*; the lever D carries coils *o, o* surrounding the ends of a magnet F. Owing to the contact between the roller *a* and the finger *b'* of the lever B the coils *o, o* in the field of the magnet F are attracted by the magnet and bring the lever D against the stop *p*; the spring *n* is thus extended and imparts energy to the pendulum

just as the weight m does in the device shown in Fig. 1. As soon as the pendulum has passed the vertical position the contact ceases being broken at b' by the roller a moving off of finger b' and the whole movable system comes to rest again on the stop i . At the end of the lever D is an anchor escapement which governs a clockwork driving the hands.

10 In the modification shown in Fig. 3 a spring B carries the finger b' and normally rests against the stop p . When the pendulum passes its vertical position the spring is displaced by the roller a which comes into
15 contact with the finger b' . The end q of the spring B is thus brought against the end f of the armature D of the electromagnet E . The attraction of the armature bends the spring B so that the pendulum which
20 has performed work in displacing the spring receives more energy than that which is expended for the purpose, after it has passed its vertical position. After roller a has
25 passed off of spring B , the spring returns to its position against stop p , thus breaking contact between the end q of spring B and contact f . The armature D can control a clockwork, for instance by a pawl driving a
30 ratchet wheel k held from revolution in the opposite direction by a detent.

In the modification shown in Fig. 4 the spring B has the same degree of tension before and after the pendulum has passed its vertical position but acts for a longer time
35 after this position has been passed. Normally its end q bears against the armature D of the driving magnet E . The roller a as the pendulum passes the vertical position displaces the spring by coming into contact
40 with the finger b' , and establishes an electric circuit through the magnet E and the armature D is attracted. When the pendulum has passed its vertical position, spring B
45 will have a longer stroke before it is brought to rest by reason of the armature D being attracted and will therefore act for a longer time to impel the pendulum. It is this difference of stroke which is the origin of the necessary restitution of energy. The circuit
50 is broken by roller a of pendulum A passing off of finger b' of spring B . Thereupon armature D falls and partially depresses spring B , thereby tensioning it for imparting another impulse to the pendulum
55 as it swings back across its center of oscillation.

In Fig. 5 the invention is applied to the control of a balance wheel having a spiral spring, for instance in an electric chronometer which may be used as a self-controlled clock or as a transmitter for controlling electric receivers. The pivot of the balance wheel A carries a small roller a balanced
60 by a weight s ; as the roller passes the dead point it bears against the spring B and thus

closes the circuit of an electromagnet E through the extremities of arm B and armature D . The spring B being put in tension by the roller a gives rise to a tangential force adapted to maintain the oscillation
70 of the balance wheel A . In this manner the full oscillation of 360° (180° on each side of the dead point) which is necessary for the satisfactory working of the system may be obtained. The armature D of the electro-
75 magnet which drives the system controls the clockwork through a device not shown. The balance wheel A carries two weights u, u' which can be fixed in position by means of screws to vary the effective lengths t, u
80 and t', u' .

In the modification shown in Fig. 6 the roller a moves the lever B as it passes its end b , which is V-shaped for the purpose.

Instead of the roller carried by the rectilinear pendulum or the balance wheel,
85 there may be used if desirable a jewel, such as an agate, ruby or sapphire, or a piece of polished steel or the like cut to a convex profile but this arrangement entails more
90 friction.

The jewel cannot be used as a conductor of the current as is the case with the roller in some instances indicated in the foregoing
95 description. When the roller is to conduct the current it is made of a metal which is incapable of oxidation and the current may be conducted to it (Fig. 7) by a very weak spiral spring x soldered at one end to the
100 pivot z and at the other end to the pendulum rod y so as to avoid passage of the current through the lubricant of the pivot. The current can also be conducted through a light blade spring applied to the pivot of the roller and thus forming a brush.
105

In all the examples the pendulum or balance wheel receives its impulse when the roller of the pendulum or balance wheel encounters normally the weighted lever or spring lever which is to impart the impulse
110 needed by the pendulum or balance wheel. The amplitude of the impulse is independent of the voltage of the battery, inasmuch as the action of the electro-magnet (either by the attraction or weight of its armature)
115 is to raise the weight, or tension the spring, to a limited extent, whereby energy is stored in the weight or spring for giving the required impulse to the pendulum. The energy stored in the spring or weight is a
120 fixed quantity, so that the impulse given the pendulum, as a consequence, is a constant one.

Having thus described my invention and the best means I know of carrying the same
125 into practical effect, I claim:—

1. An electric clock, comprising an oscillating element, a spring arm with which said oscillating element is adapted to come in contact, during its oscillation, in the posi-
130

tion of rest of said element, and electro-magnetic means tensioning said spring arm to impart an impulse to said oscillating element during contact therewith, said spring arm by its displacement by said oscillating element establishing a circuit for current for energizing said electro-magnetic means, and said oscillating element being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm.

2. An electric clock, comprising a train of gears, an oscillating element disconnected therefrom, a spring arm with which said oscillating element is adapted to come in contact during its oscillation, in the position of rest of said oscillating element, and an electro-magnet adapted to tension said spring arm to impart an impulse to said oscillating element during contact therewith, said oscillating element being free to swing in either direction of oscillation after receiving its impulse from said arm.

3. An electric clock, comprising a train of gears, an oscillating element disconnected therefrom having a roller thereon, a spring arm having a stud thereon with which the said roller on said oscillating element is adapted to come in contact during its oscillation, in the position of rest of said oscillating element, and an electro-magnet adapted to tension said spring arm to impart an impulse to said oscillating element during contact therewith, said oscillating element being free to swing in either direction of oscillation after receiving its impulse from said arm.

4. An electric clock, comprising a train of gears, a balance wheel, a spring arm with which said balance wheel is adapted to come in contact during its oscillation, in the position of rest of said balance wheel, and an electro-magnet adapted to tension said spring arm to impart an impulse to said balance wheel during contact therewith, said balance wheel being disconnected from said train of gears and free to swing in either direction of oscillation after receiving its impulse from said arm.

5. An electric clock having an oscillatory member for regulating the movement thereof, an arm lying within the arc of movement of said oscillatory member and adapted to impart impulses of constant force thereto, said impulses being imparted to said member as it passes to either side of its center of oscillation and in the direction of its outward movement, and an electro-magnet adapted to vary the relation of said arm to said arc said oscillating member being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm.

6. An electric clock having an oscillating

member for regulating the movement thereof, an arm lying in the path of movement of said oscillating member for imparting impulses of constant force thereto, said impulses being imparted to said oscillating member as it passes to either side of its center of oscillation and in the direction of its outward movement, and an electro-magnet supplying said means with energy for each impulse, the energization of said magnet being controlled by said arm and oscillating member said oscillating member being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm.

7. An electric clock having an oscillating member for regulating the movement thereof, a spring arm adapted to impart impulses to said oscillating member as it passes to either side of its center of oscillation and in the direction of its outward movement, and an electro-magnet tensioning said spring arm for each impulse said oscillating member being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm.

8. An electric clock having an oscillating member for regulating the movement thereof, a spring arm adapted to impart impulses to said oscillating member as it passes to either side of its center of oscillation and in the direction of its outward movement, an electro-magnet tensioning said spring arm for each impulse, and stops for limiting the movement of said spring arm by said electro-magnet said oscillating member being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm.

9. An electric clock having an oscillating member for regulating the movement thereof, an arm lying in the path of movement of said oscillating member for imparting impulses of constant force to said oscillatory member, said impulses being imparted to said oscillatory member as it passes to either side of its center of oscillation and in the direction of its outward movement, an electro-magnet supplying said means with energy for each impulse, the energization of said magnet being controlled by said oscillating member, said oscillating member being disconnected from the clock mechanism and free to swing in either direction of oscillation after receiving its impulse from said arm, a train of gears, and means operated by said electro-magnet for actuating said train of gears.

10. An electric clock having an oscillating member for regulating the movement thereof, said oscillatory member having a projection thereon, a spring arm adapted to be

struck by the projection on said oscillatory member and to impart impulses to said oscillating member as it passes to either side of its center of oscillation and in the direction
5 of its outward movement, an electric contact adapted to be closed when said projection engages said spring arm, a battery, an electro-magnet, and an electric circuit including
10 said battery, electro-magnet, spring arm and contact, said electro-magnet being energized

upon the closing of said circuit and tensioning said spring arm for each impulse.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

CHARLES FÉRY.

Witnesses:

DEAN B. MASON,
RENS BARDY.