(No Model.)

R. E. FENNER.

ELECTRIC CLOCK.

No. 345,292. Patented July 13, 1886.

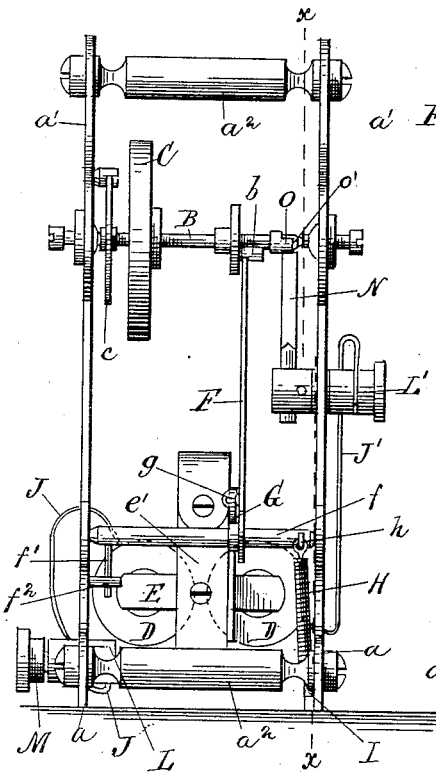

Fig 1

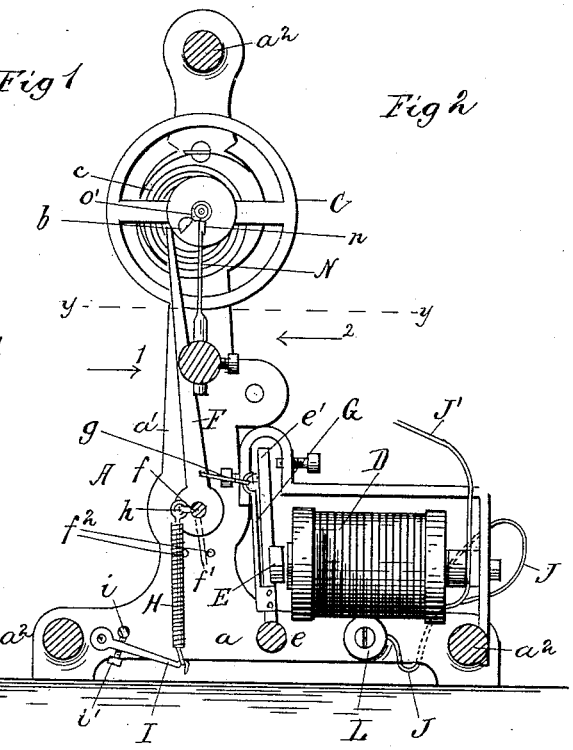

Fig 2

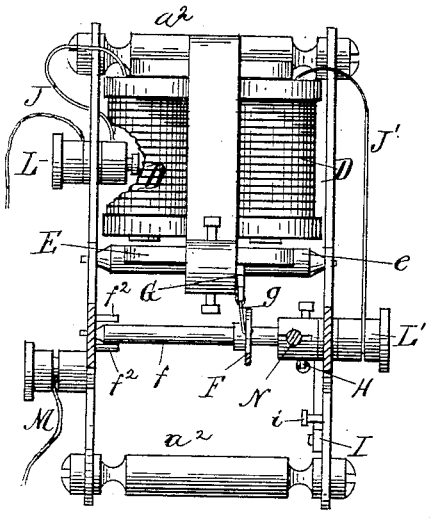

Fig 3

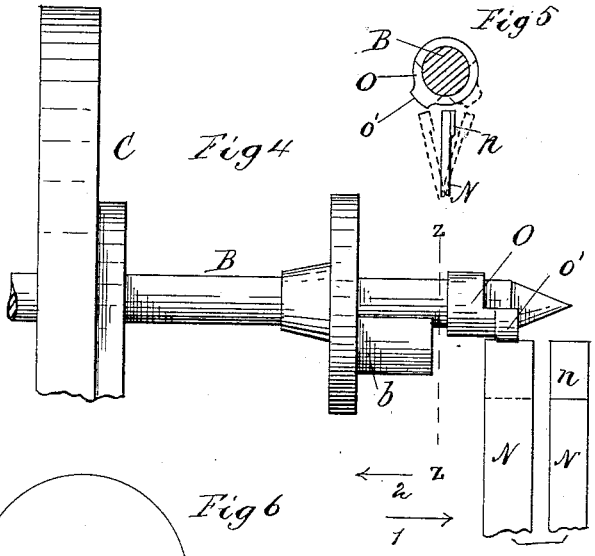

Fig 4

Fig 5

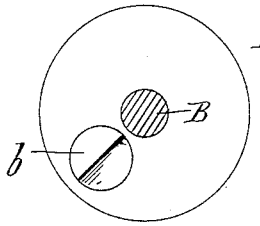

Fig 6

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UNITED STATES PATENT OFFICE.

RICHARD E. FENNER, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO CHARLES K. GILES, OF SAME PLACE.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 345,292, dated July 13, 1886.

Application filed September 21, 1885. Serial No. 177,765. (No model.)

To all whom it may concern:

Be it known that I, RICHARD E. FENNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Clocks, which are fully set forth and described in the annexed specification, reference being had to the accompanying drawings, in which—

Figure 1 represents an end elevation of a portion of a clock embodying my improvements; Fig. 2, a section of the same taken on the line *x x*, Fig. 1; Fig. 3, a plan section of the same, taken on the line *y y*, Fig. 2; Fig. 4, a detail elevation of the balance and its arbor, taken on an enlarged scale; Fig. 5, a cross-section of the same, taken on the line *z z*, Fig. 4, and looking in the direction of the arrow 1; and Fig. 6, a similar view on the same section, looking in the direction of the arrow 2.

My invention relates to clocks which are intended to be operated by electricity, instead of springs, weights, or other like devices. The usual mode of effecting this result is by means of an electro-magnet connected with a suitable battery to supply current thereto, and mechanism connected to the armature, which is operated by the vibrations of the latter to impart the necessary motion to the clock-movement, the vibrations of the armature being produced by the opening and closing of the circuit by a circuit-breaker operated in some way by the movement.

The object of the present invention is to apply this general principle of operation to balance-wheel clocks.

I will proceed to describe in detail one way in which I have carried out my invention in practical form, and will then point out definitely in the claims the special improvements which I believe to be new and wish to protect by Letters Patent.

In the drawings, A represents a supporting-frame, which consists of two side bars, *a*, at the base, from which rise two uprights, *a'*, preferably made in one piece therewith. These pieces are connected by suitable cross-bars, a^2, two at the base and one at the top. The arbor B of the balance C is mounted in the uprights of the frame A, and is provided with the usual balance or hair spring *c*. These parts and their mounting do not differ materially from the ordinary construction of clocks of this type, and hence do not require specific description. A pallet-jewel, *b*, is attached to the arbor in any suitable manner some little distance from the balance, and is preferably plane on one face and convex on the other, and its location is such that when these parts stand normally at rest it will depend about vertically from the arbor. An electro-magnet, D, is mounted on the base of the frame, preferably with its cores horizontal. The armature E for this magnet is mounted on a rock-shaft, *e*, journaled in the base of the frame, being provided with an upright arm, *e'*, to which the armature is fastened. A lever, F, which may be called the "impulse-lever," is fastened at its lower end to a rock-shaft, *f*, mounted in the lower portion of the uprights of the frame A some distance below the arbor of the balance. This lever extends upward nearly to the arbor, and near its lower end is connected to a spring, G, by a link or rod, *g*, or any other suitable connection. The spring G is fastened at one end to the armature, or to the upright on which the latter is mounted, and is preferably a straight plate-spring, though the form is not an essential. A retractile spring, H, is fastened at one end to an arm, *h*, on the rock-shaft of the impulse-lever, and at the other end to the extremity of a pivoted lever, I, fastened to the frame. A stop-pin, *i*, is arranged over this lever I, to limit its upward vibration under the influence of the spring, and an adjusting-screw, *i'*, passes through the lever, and is arranged to work against the pin, whereby the relative position and vibration of the lever may be regulated, and so obviously the tension of the retractile spring adjusted. The retractile spring is arranged so that its action will be to vibrate the rock-shaft in a direction to pull the armature away from the magnet, and so, of course, when left to the influence of this spring, the impulse-lever will stand on the side of the pallet opposite to the magnet and its armature, as shown in Fig. 2 of the drawings, in which it will also be seen that the convex surface of the pallet is on the same side as the lever. An arm, *f'*, depends

from the rock-shaft *f* near its other end and hangs between the two pins f^2 on the frame. The purpose of this device is to limit the oscillations of the shaft. Now, it is obvious that when the magnet is charged and the armature is drawn toward its poles the impulse-lever will also be vibrated toward the pallet on the balance-arbor, and, striking it, will give an impulse to the balance, producing an oscillatory movement; but the moment the circuit is broken, the armature being no longer attracted by the magnet, the retractile spring will at once vibrate the impulse-lever in the opposite direction. It is obvious, then, that a device for making and breaking circuit at the proper moments is necessary, and I will now proceed to describe the mechanism by which I accomplish this. One terminal wire, J, of the electro-magnet is connected to a binding-screw, L, on the base portion of the frame, and the other terminal, J′, to a similar screw, L′, on one of the uprights of the frame. Both of these binding-screws L and L′ are insulated from the frame in any usual way. Another binding-screw, M, is attached to some portion of the frame, preferably, for convenience, to the base, and on the same side as the screw L, as shown in the drawings. The battery-wires are connected, respectively, to the two binding-screws L and M, as seen in Fig. 3 of the drawings, the battery, however, not being shown. It will be seen from this connection that the wire at the binding-screw M brings the frame into the circuit, and that the wire at the screw L brings the magnet into circuit, and that this portion of the circuit extends only to the binding-screw L′, which is insulated from the main frame, so that to complete the circuit connection must be made between the binding-screw L′ and the main frame. It is this connection which I have constructed so as to constitute a circuit-breaker, or rather a device for both breaking and making the circuit, as required in the operation of the clock. On the inner end of the binding-screw L′ is mounted a spring, N, of any suitable metal—platinum, for instance—which is extended upward to the arbor of the balance, where it comes in contact with a cam projection or enlargement, O, on the arbor, extending part way around the latter. This projection may be provided in any suitable way. In the drawings I have shown it as a part of a collar fixed on the arbor, but cut away so as to leave the projection on the under side of the arbor when the latter stands in a normal position of rest, and preferably it is provided with a slight boss, *o′*, with which the upper end of the spring is brought in contact when the arbor is at rest, as mentioned above. Now, it is evident that whenever this spring is in contact with the cam the circuit will be closed, for through the binding-screw M the current flows through the frame to the balance-arbor, and so to the cam projection thereon, and the spring which is connected to the binding-screw L′, that in turn is connected with the other pole of the battery, whenever brought in contact with the cam on the arbor, will obviously complete the circuit, and the current will flow either in one direction or the other, it is immaterial which. So, too, whenever the spring is out of contact with the cam on the arbor, or insulated therefrom, the circuit will obviously be broken. It is plain that the oscillation of the balance-arbor will make and break contact between the spring and the cam on the arbor, and so a circuit breaker and maker is provided which is operated by the movement of the balance. Now, suppose the parts are at rest and connection be made with the battery. The circuit-breaking spring being in contact with the cam, the electro-magnet will at once be charged, the armature will be attracted to the magnet, and so the impulse-lever will be vibrated toward the pallet, which it strikes, thereby giving an oscillatory impulse to the arbor and balance in the direction indicated by the arrows 1 in Fig. 2 of the drawings. This movement of the arbor will carry the cam out of contact with the spring, as shown in Fig. 5 of the drawings, when, of course, the circuit will be broken, the magnetic force of the electro-magnet will be destroyed, and the armature released will at once be retracted by the retractile spring, the impulse-lever being carried with it. Under the ordinary action of the spring-balance the arbor will soon commence a return movement in the direction of the arrow 2 of Fig. 2 of the drawings, when, of course, contact between the spring and cam will soon be restored; but this would at once close the circuit, charge the magnet, and vibrate the impulse-lever again at an improper time, as the balance should have a free opportunity to complete its return oscillation. Now, in order to prevent this result, I insulate what may be called the "back" side or obverse face of the spring by applying thereto a thin strip, *n*, of ivory, rubber, or any other suitable insulating material. Now, when the cam O comes in contact with the spring on its return movement, it strikes this insulating material, so that the circuit is not closed, and this contact is continued as the cam carries the spring to one side, as shown in Fig. 5 of the drawings, finally sweeps past it, and is again free therefrom. The movement in the opposite or first direction of the balance will soon begin, and as soon as the cam is again brought into connection with the spring, when the parts are about in the relative position shown in Fig. 2 of the drawings, the circuit will be closed, the lever vibrated again, and another impulse given to the balance, and so the movement is kept up continuously by the successive impulses given by the vibrating lever.

The mechanism is compact, simple, and efficient, and I have found by practical test that it is satisfactory in its operation. It is obvious, however, that changes may be made without changing the general principle of op-

eration which characterizes my invention; hence I do not wish to be understood as limiting myself to the particular devices and arrangement of devices which are here shown and described; nor do I wish to be understood as limiting my improvement to the particular circuit-breaker herein specified, for it is plain that some other device may be employed to effect the same result, while the other parts of the mechanism remain substantially the same as here shown. By a proper reversal of the relation of the impulse-lever, arbor, and circuit-breaker, the lever may be made to give its impulse on the other side of the pallet, instead of as described above, acting then under the influence of the retractile spring, while the magnet acts to bring it back on its inoperative stroke. In such an arrangement the force of the retractile spring should be nicely adjusted, so as to be always uniform. There is, however, no obstacle to the successful working of the mechanism arranged as described, and shown in the drawings, for any variation in battery force which might tend to make the movement of the impulse-lever more or less sudden or jerky is counteracted by the elastic connection between the lever and the armature effected by the spring on the latter, to which the connecting-link is attached.

It will of course be understood that the usual clock-work is combined with the balance in any ordinary way, which being well known and readily understood, I have not herein illustrated and described.

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

1. The spring-balance of a clock, in combination with an electro-magnet, a vibrating armature, a vibrating impulse-lever connected to the armature and arranged to act upon the arbor of the balance, a retractile spring connected with said lever, and an automatic circuit breaker and maker, substantially as and for the purposes set forth.

2. The spring-balance of a clock, in combination with an electro-magnet, a vibrating armature, a vibrating impulse-lever connected to the armature, and an automatic circuit breaker and maker consisting of a contact-point on the balance-arbor and a contact-spring constructed and arranged to be operated by the oscillation of the balance-arbor, substantially as and for the purposes set forth.

3. The spring-balance of a clock, in combination with an electro-magnet, a vibrating armature, a vibrating impulse-lever elastically connected to the armature, and an automatic circuit breaker and maker, substantially as and for the purposes set forth.

4. The electro-magnet, in combination with the spring-balance, the arbor of the balance provided with the cam O, and the spring N, provided with insulating material *n* on one side, at its contact end, substantially as and for the purposes set forth.

5. The clock-balance, in combination with the electro-magnet, the vibrating armature, the spring connected to the armature, and the vibrating impulse-lever connected to the spring, substantially as and for the purposes set forth.

6. The clock-balance, in combination with the electro-magnet, the vibrating armature, the vibrating impulse-lever F, mounted on the rock-shaft *f*, the retractile spring H, and the adjustable lever L, to which the spring is connected, substantially as and for the purposes set forth.

7. The electro-magnet, in combination with the vibrating armature, the vibrating impulse-lever F, mounted on the rock-shaft *f*, the arm *f'* on said rock-shaft, the limit-pins *f²*, and the retractile spring G, substantially as and for the purposes set forth.

8. The electro-magnet, in combination with the insulated binding-screw L′, the spring N, mounted on said binding-screw and provided with insulating material on one side, and the balance-arbor B, provided with the cam O, substantially as and for the purposes set forth.

9. The supporting-frame, in combination with the insulated binding-screws L and L′, binding-screw M, the battery-wires connected, respectively, to the binding-screws L and M, the electro-magnet with its terminals connected, respectively, to the insulated binding-screws, the partially-insulated spring N on the binding-screw L′, the arbor B, provided with cam O, the clock-balance C, the impulse-lever F, connected to the armature of the magnet, and the retractile spring G, substantially as and for the purposes set forth.

RICHARD E. FENNER.

Witnesses:
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J. M. PARSHALL.