(No Model.) 3 Sheets—Sheet 1.

W. L. STEVENS & E. J. WESCOTT.

PRIMARY ELECTRIC CLOCK.

No. 330,938. Patented Nov. 24, 1885.

Fig. 1.

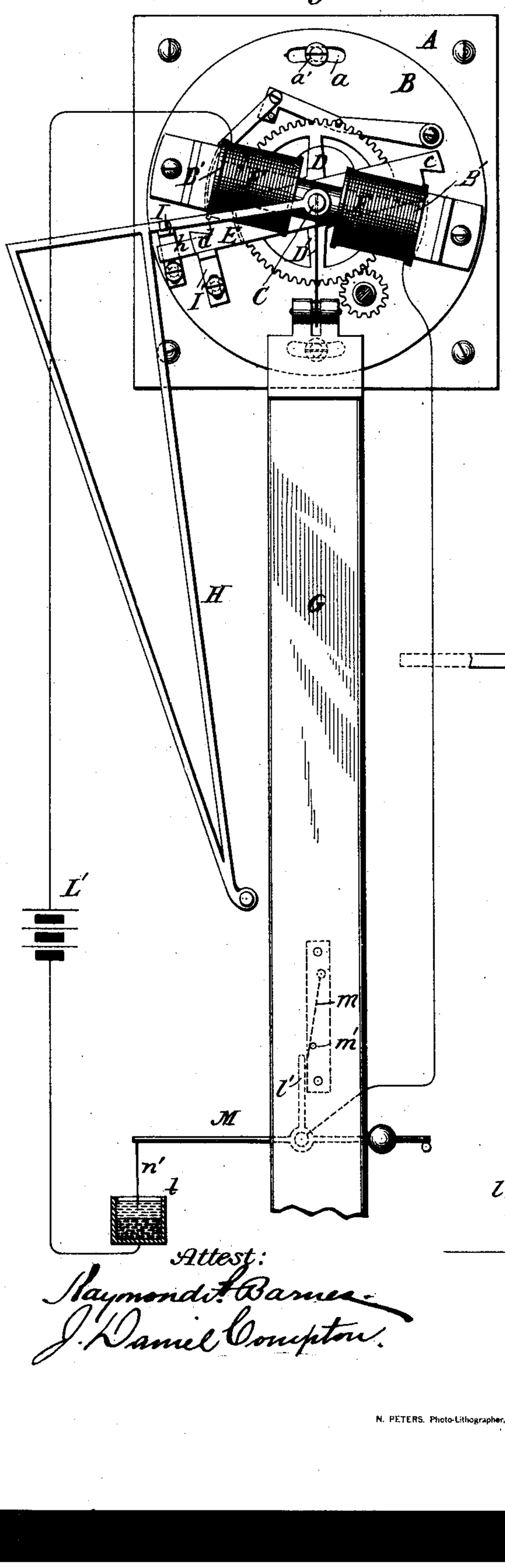


Fig. 2.

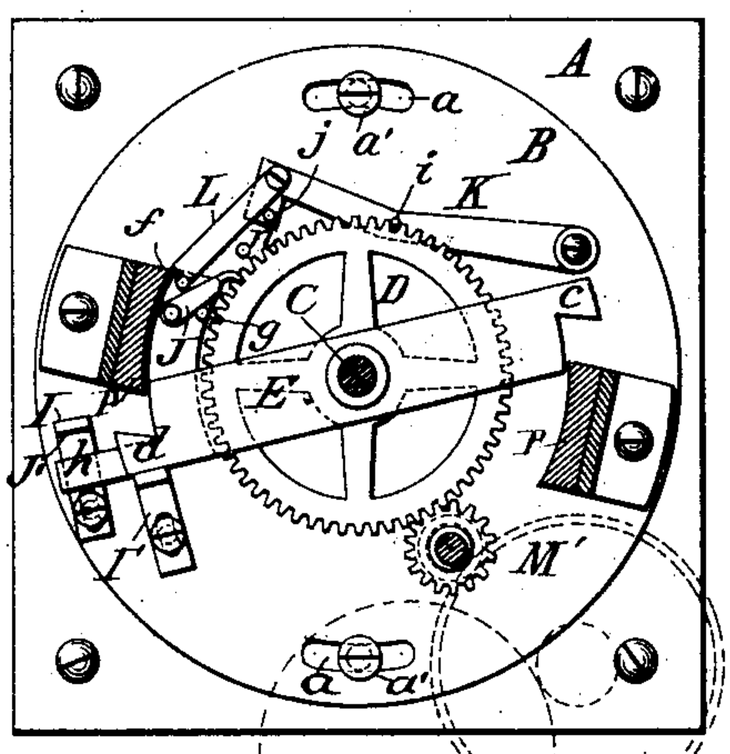


Fig. 3.

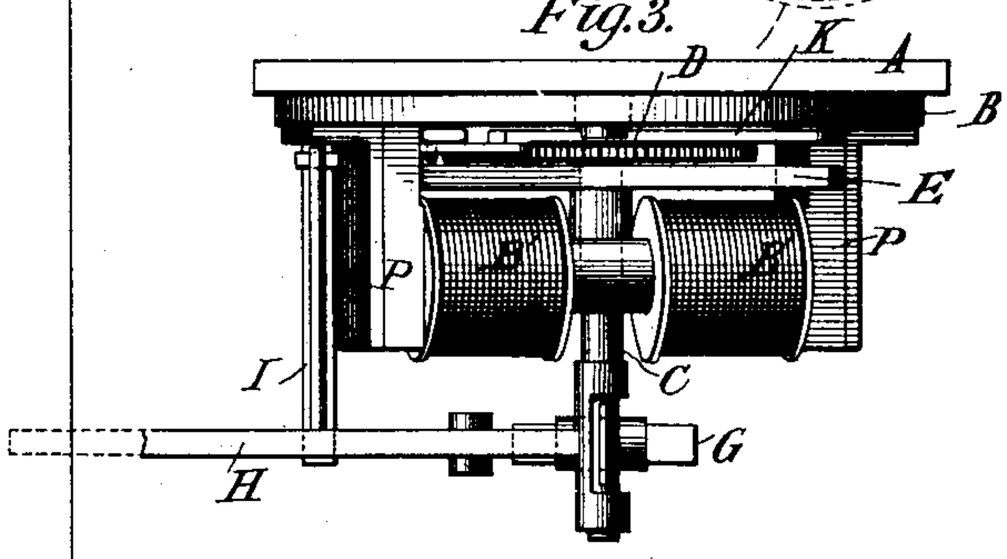
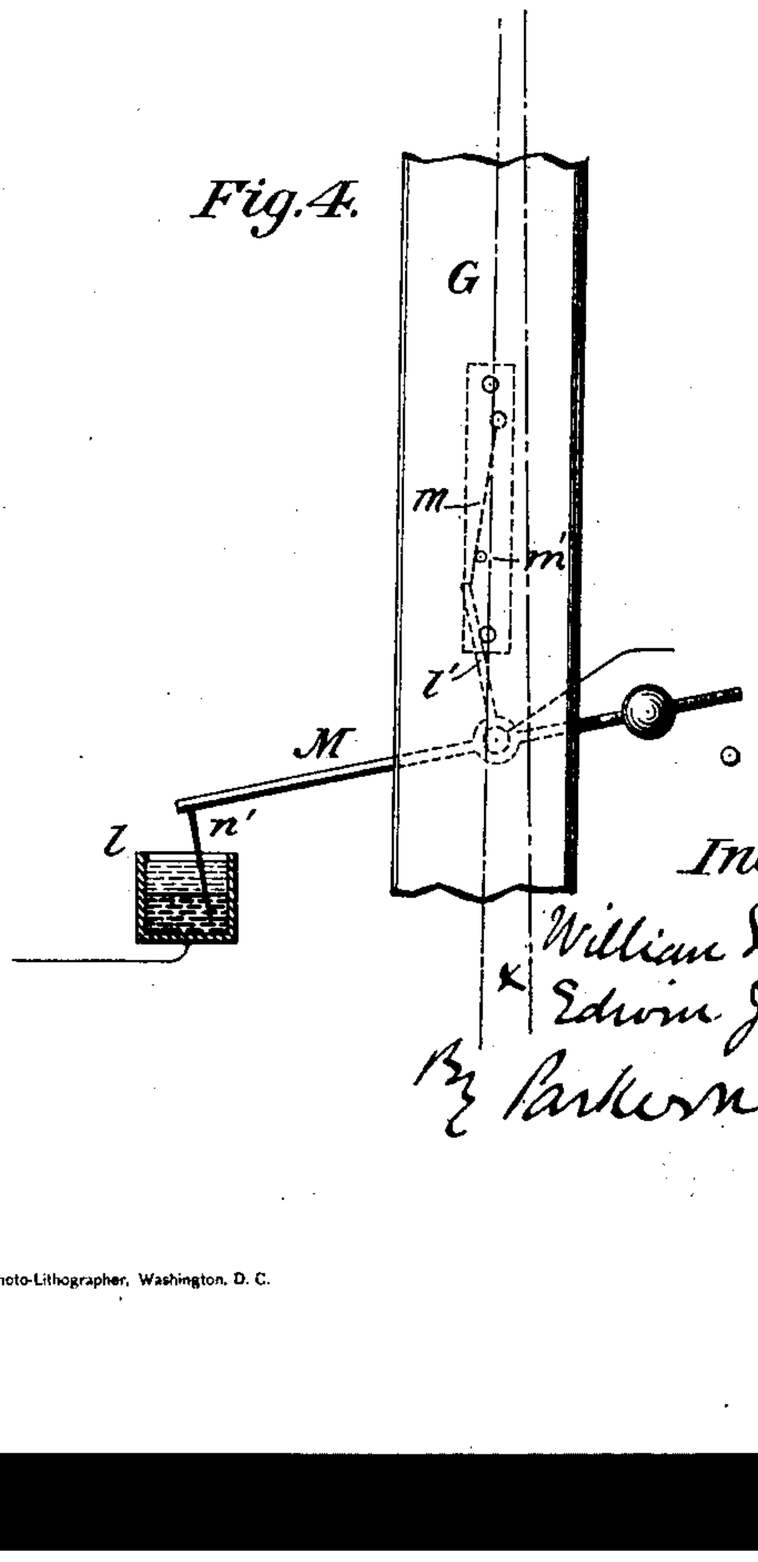


Fig. 4.



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W. L. STEVENS & E. J. WESCOTT.

PRIMARY ELECTRIC CLOCK.

No. 330,938. Patented Nov. 24, 1885.

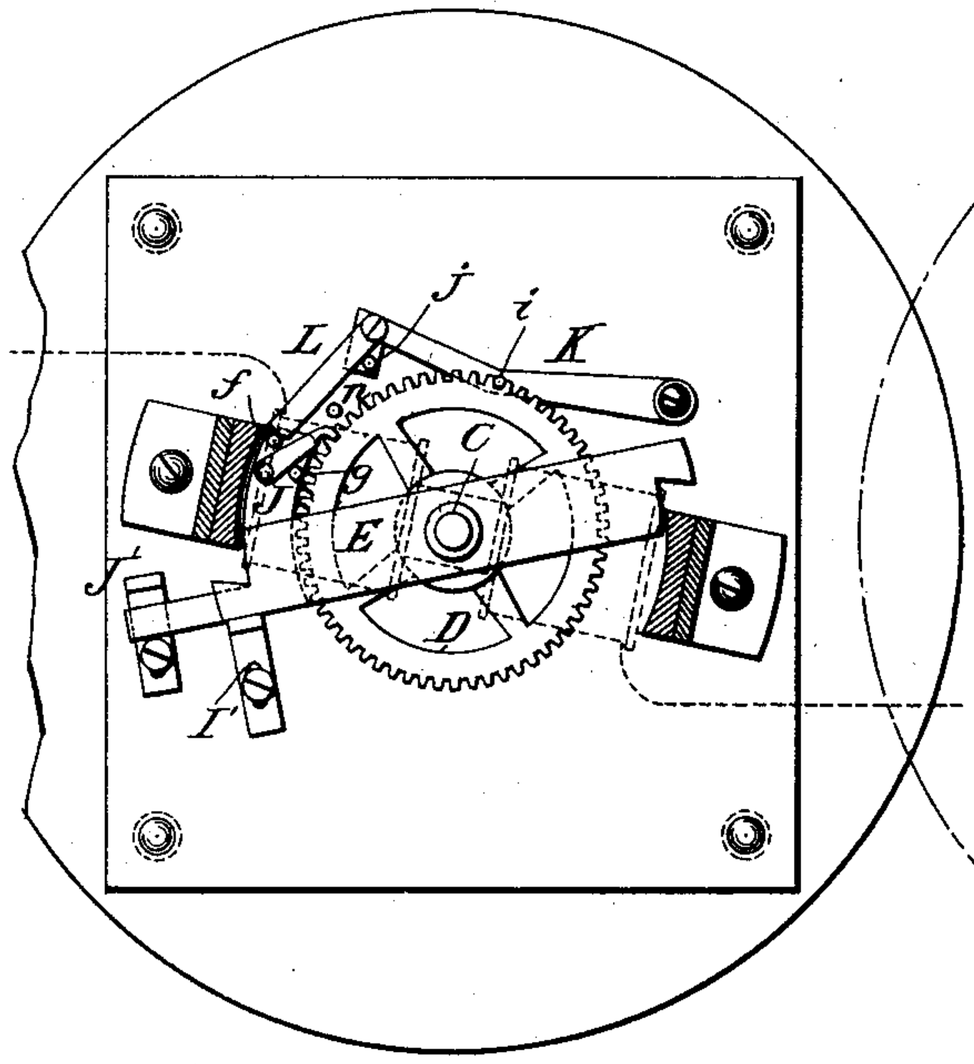


Fig. 5.

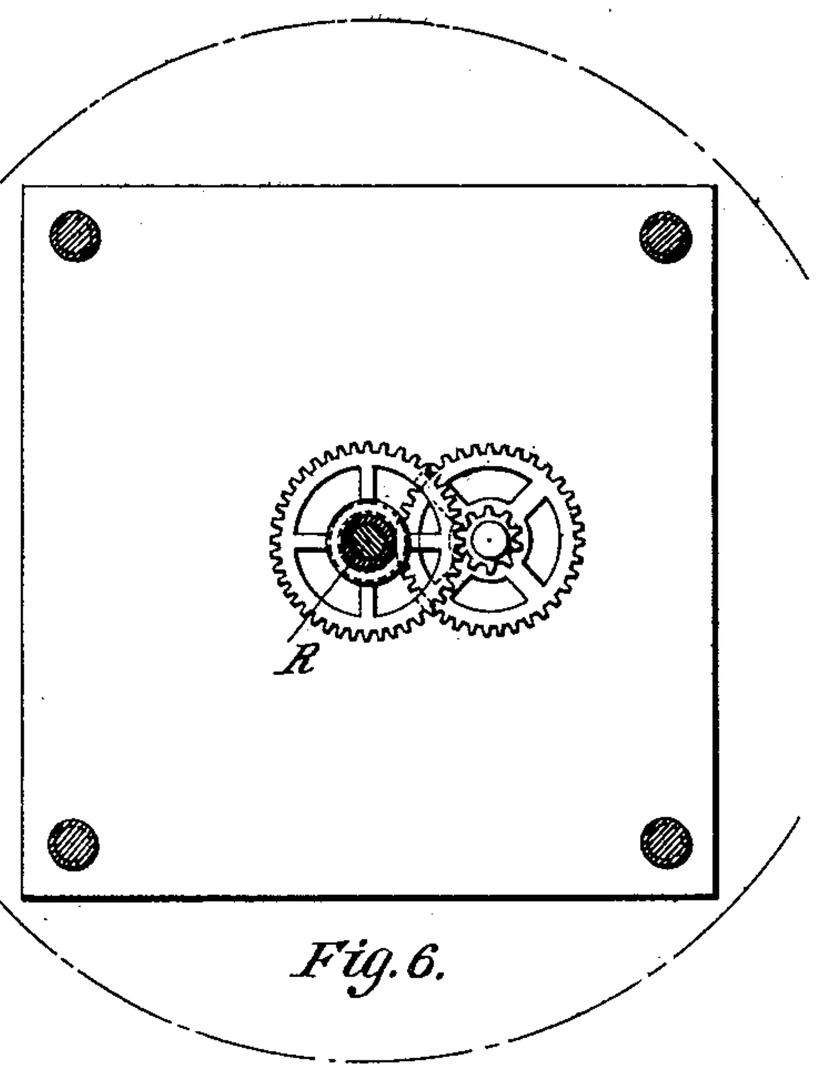
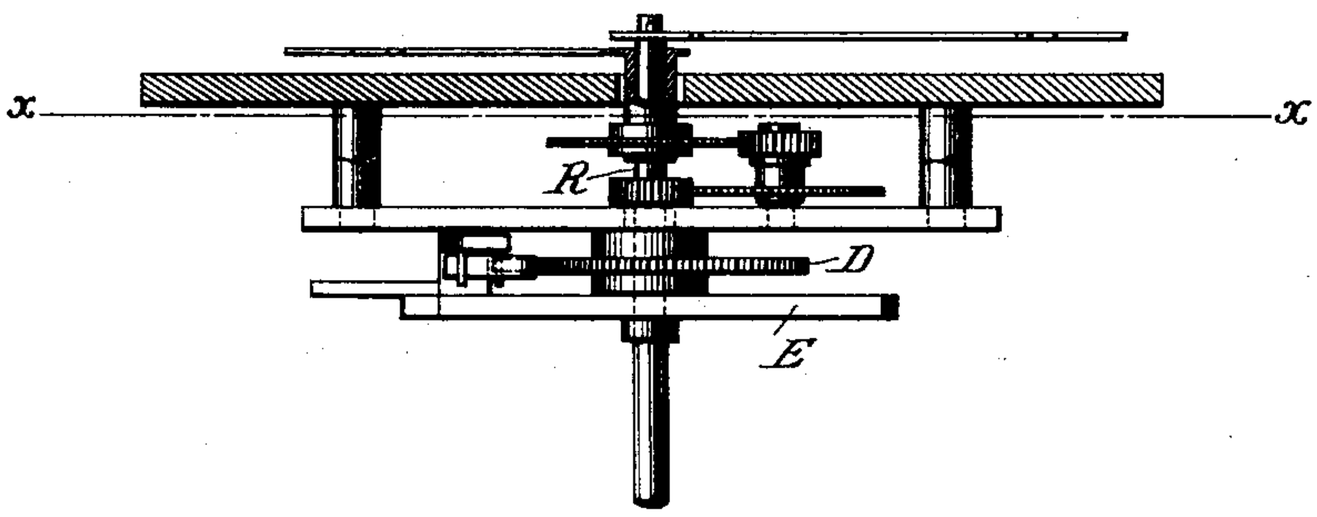


Fig. 6.

Fig. 7.



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PRIMARY ELECTRIC CLOCK.

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Fig. 8.

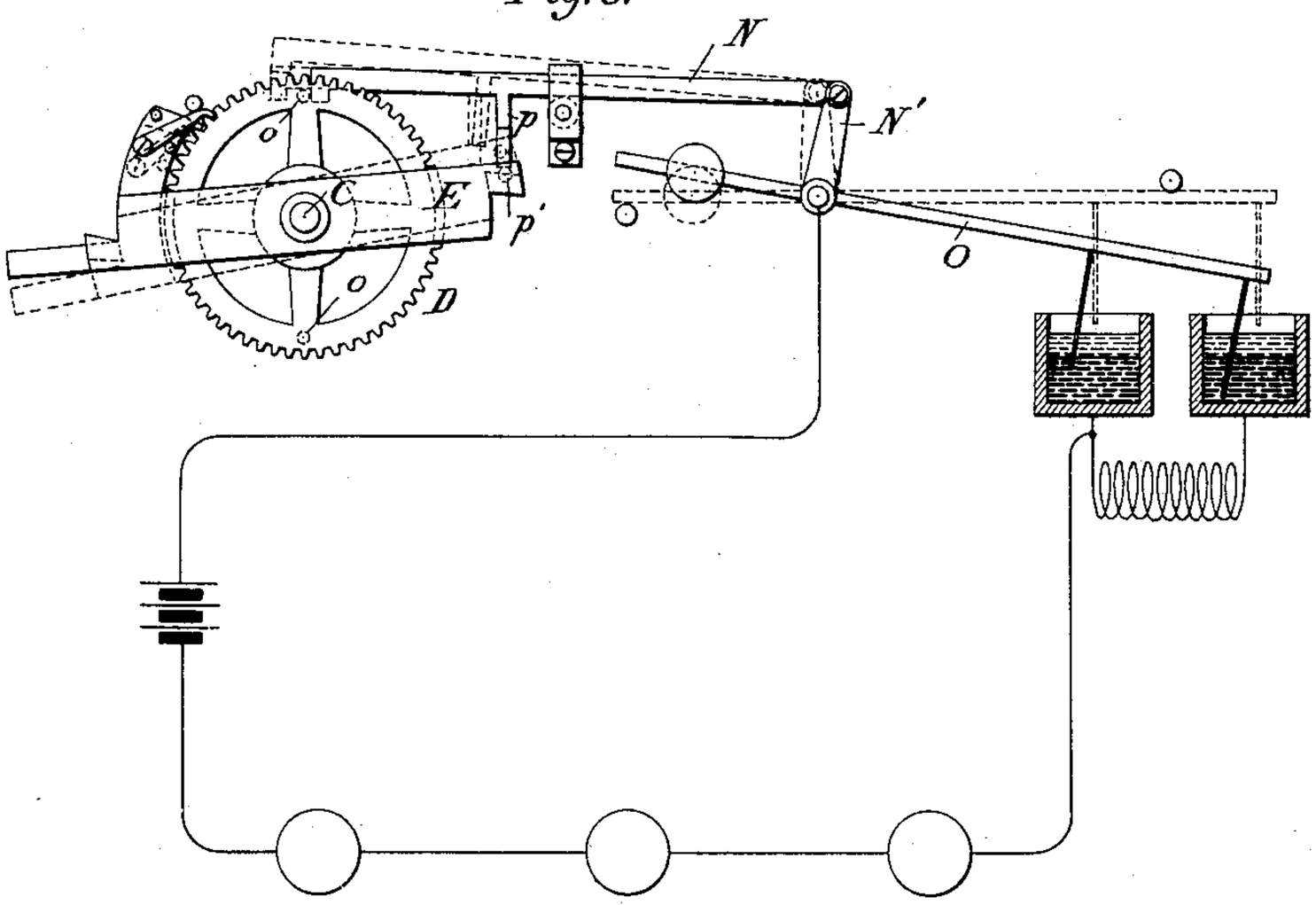
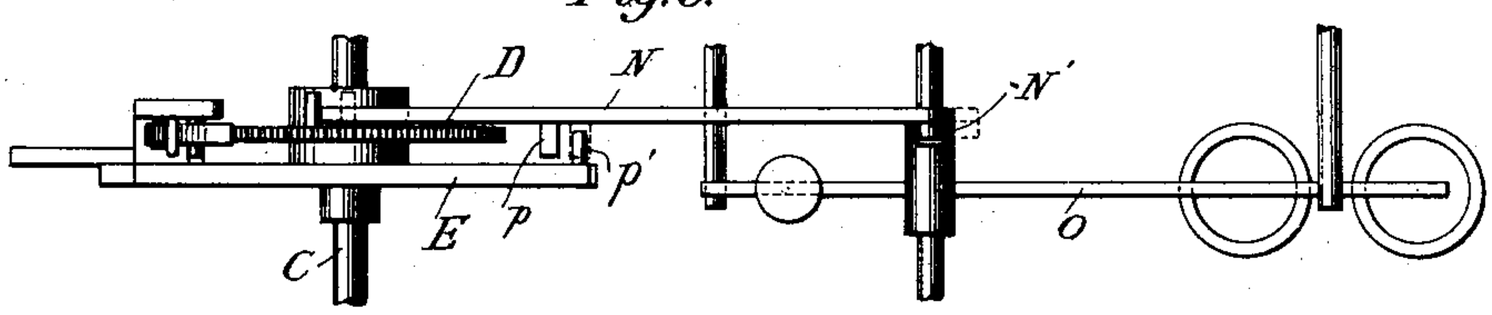


Fig. 9.



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UNITED STATES PATENT OFFICE.

WILLIAM L. STEVENS, OF DORCHESTER, AND EDWIN J. WESCOTT, OF HYDE PARK, MASSACHUSETTS.

PRIMARY ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 330,938, dated November 24, 1885.

Application filed July 27, 1885. Serial No. 172,763. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM L. STEVENS and EDWIN J. WESCOTT, citizens of the United States, and residing, respectively, at Dorchester, in the county of Suffolk, and Hyde Park, in the county of Norfolk, and State of Massachusetts, have invented certain new and useful Improvements in Electric Clocks, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

Our invention is an improvement in that class of electric clocks or clock systems in which at given intervals of time electrical impulses of current are transmitted from a primary clock or regulator to one or more secondary time-pieces, and in which the movement of the primary clocks is dependent in part upon electro-magnetic action.

The general character of the system and the principle of its operation are as follows: As the primary clock or regulator, we employ a toothed wheel arranged to be rotated step by step by a device comprising a pawl and system of locking mechanism and an armature of an electro-magnet, which armature is mounted so as to turn or revolve about a center. The action of the electro-magnet is dependent upon the movement of a pendulum, which operates as a circuit-closer, and which is kept in motion by the influence of a weight, which is raised by the said armature, and has a movement in the path of the pendulum. The toothed wheel rotated by this combination of devices has one or more pins or stops that once or twice in each revolution of the wheel close a circuit exterior to the clock, which in turn either directly or indirectly operates the other or secondary clocks, so that their movements are in unison with those of the primary.

The mechanism of the secondary clocks is or may be substantially the same as that of the primary, omitting the pendulum, which, as it serves only as a circuit-closer, is not required on more than one of the clocks of the system.

Heretofore in electrical time or clock systems apparatus constructed on the same general principle as that above described has been employed—that is to say, it is not new to keep a pendulum in motion by the fall of a weight raised by an electro-magnet, which also operates to close a circuit at certain intervals—say every minute or half-minute—to one or more secondary clocks; but our invention involves many features of novelty and novel applications of principles distinct from this, and which contribute greatly to the better running of such systems, and produce a simpler and more efficient apparatus.

In the drawings hereto annexed, Figure 1 is an elevation of the operative portions of a primary clock or regulator constructed in accordance with our invention. Fig. 2 is a view of a portion of the same with magnets, weight, and pendulum removed. Fig. 3 is a top view of the primary-clock mechanism. Fig. 4 is a side view of a portion of the pendulum, showing its relative position when closing the circuit. Fig. 5 is a rear view of the mechanism of the secondary clocks or dials. Fig. 6 is a section on line *x x* of Fig. 7, which is a top view of the secondary-clock mechanism. Fig. 8 is a view of the devices for completing the circuit to the secondary clocks, and the same being shown partly in diagram. Fig. 9 is a plan view of the same.

Similar letters of reference indicate corresponding parts in the several figures referred to.

Referring to Figs. 1, 2, and 3, which show the primary clock, A is a base or plate, to which is secured by the slots *a* and screws *a'* a comparatively thick brass plate, B. In the plate B is set a hard-metal pin or stud, C, the end of which may be held by any arm or frame which it may be most convenient to employ. Upon this stud, which is fixed against rotation, is mounted near the plate B a toothed wheel, D. Next to or above this wheel is a soft-iron plate, E, forming the armature for an electro magnet or magnets, F. This magnet consists of a soft-iron core with right-angled pole-pieces P, which are secured to the brass plate B. The stud C passes through the middle of the core, which forms a kind of frame, that affords a firm support for the stud. On either side of the stud are wound the coils B' B'. The armature E is mounted so as to turn freely on the stud C, care being taken that its movement in nowise effects that of the wheel

D, except through the instrumentality of the devices hereinafter described. A portion of this armature is of such length that it moves between the poles of the magnet without coming in contact therewith; but it has extensions *c d*, that limit the movement of the armature between the poles. The effect of this construction is to vastly increase the attractive force or effect when the magnet is energized, so that a positive movement through a short space is imparted to the armature by even a very feeble current. We have found the successful operation or action of this apparatus to be in large measure due to this special form of magnet and armature. To the stud C is also attached, by means of a flexible steel strip, D′, a pendulum, G, and in the path of movement of the said pendulum is a weighted lever, H, that is mounted upon the stud C, so as to turn freely thereon. The downward movement of this lever is limited by a stop, I. The armature E has either formed on it or attached to it a projection, *e*, to which is pivoted a pawl, J. There are also two pins or studs, *f g*, on this projection, upon the latter of which rests the pawl J. The projection *d* is extended to a greater length than the projection *e*, and carries an arm, *h*, that extends under the lever H, so that when the armature is moved by the attraction of the magnet or raised, as it will hereinafter be designated, the arm *h* raises the lever H. The return movement of the armature or the movement away from the poles of the magnet is limited by a stop, I′, and its upward movement by a stop, J′.

To the plate B is pivoted a lever, K, having a pin, *i*, that enters the teeth of the wheel D and locks the same against movement. To the end of this lever is loosely pivoted an arm, L, that rests upon a pin, *j*, on the lever, and the end of which rests upon the pin *f* on the armature. The coils of the magnet are included in the circuit of a battery, L′, which contains as a circuit-breaker a balanced lever, M, that dips into a mercury-cup, *l*. This lever is pivoted beside the pendulum G, and has an arm, *l′*, that extends into the path of a blade, *m*, on the pendulum. This blade is pivoted to the pendulum and has a stop, *m′*.

The operation of the parts or devices now described is as follows: As the pendulum moves to the left the circuit through the magnet is closed so that the armature is raised. Normally the wheel D is locked, but the upward movement of the armature raises the locking-lever by the engagement of pin *f* with the end of arm L, so that the pawl J, engaging with the wheel D, turns it. Just before the armature reaches its upper stop or limit of movement the arm L slips off from the pin *f* and locks the wheel D, and the pawl J passes under a pin, *n*, which is placed just beyond the limit of normal movement of the pawl, and has no effect unless the locking-lever fails to operate properly, in which case it serves to jam the pawl between the teeth of wheel D, thus preventing the momentum of the wheel from moving it beyond the space of one tooth. There should be sixty teeth, so that the wheel makes one revolution for every sixty oscillations of the pendulum. The upward movement of the armature also raises the lever H just before it is reached by the pendulum. The latter keeps the circuit closed by depressing the pin *n′* into the mercury-cup until it reaches the weighted lever H in its position to which it has been lifted by the armature. The arm *l′* then slips off the blade *m* and the circuit is broken, upon which the armature E drops back to its original position. The pendulum, however, continues its movement to the left, lifting the lever H as much higher as is necessary to enable it to finish its oscillation. As the pendulum swings back to the right, it is followed by the lever H through the distance which it was lifted by the pendulum and that through which it was raised by the armature, the extent of the latter movement determining the energy imparted to the pendulum at each oscillation. The backward movement of the pendulum does not affect the circuit, as the blade *m* simply trips over the arm *l′*. The movement imparted to the wheel D by this means is utilized to run a train of wheels, as M′, for a clock, or for closing the circuit at regular intervals to other clocks. This may be done in a variety of ways, one of which is illustrated in Figs. 8 and 9. In these figures N designates a light bar, which is supported by a suitable guide attached to the plate B. The bar N is connected with an arm, N′, from a lightly-weighted circuit-controlling lever, O, and its forward end lies normally in the path of one or more pins, *o*, on the wheel D. When, by the rotation of the wheel, therefore, one of these pins encounters the lever or bar N, it is forced over slightly to the right causing the lever O to tip and close the circuit; but in order that the period of time during which the circuit is thus closed may be very short a pin, *p*, is inserted in the bar N, and another, *p′*, in the armature E. When the bar N is moved by the pin *o*, the pin *p* is brought into the path of pin *p′*, so that the bar is raised by the return movement of the armature and carried back at once beyond the pin *o*.

The circuit-controller O may make and break the circuit to the other clocks directly, or may serve as a relay to control said circuit; and in all cases suitable devices—such as resistances, condensers, or other well-known means—should be employed to prevent the occurrence of sparks upon the breaking of the circuit. When mercury-cups are employed, the surface of the mercury, as shown in Fig. 1, should be covered with oil or glycerine.

In constructing this apparatus we prefer to rivet the pin or arbor C to the plate A, and when the locking-lever, pins, and magnet are secured to the plate B the latter is secured to the plate A by slots and screws so that it is capable of being turned through a small arc, the object of this being that after all the

other parts are properly adjusted so that the wheel rotates properly and the weighted lever is lifted through a proper distance, the plate as a whole may be turned, so as to bring the lower end of the weighted lever in correct relation with the pendulum.

The secondary clocks to be operated or controlled by the above-described primary clock are shown in Figs. 5, 6, and 7. In these the wheel D and the locking-pawl mechanism and magnet are the same as for the primary clock, except that the wheel D is made to turn a spindle, R, by which is carried the minute-hand of the dial. From this spindle the hour hand is run by any proper system of reducing gears. Of course the pendulum is not employed with the secondary clocks nor the weighted-lever for impelling it. The armature E is moved between the stops by the currents or current impulses transmitted from the primary clock, each movement imparting to the wheel D a movement of one tooth or one-sixtieth of its revolution. In this way a large number of clocks may be run from one regulator at a trifling cost, the clocks themselves, when made in accordance with our invention, being extremely cheap and simple, requiring little or no attention.

There are certain features which are particularly important in this invention. That of the armature mounted so as to turn about a center arm, having polar projections, has been already alluded to. In addition to this we find it very material to the attainment of accurate results that the wheel D be locked positively against movement at all times, except while it is being impelled forward by the armature. Our arrangement of pawl or locking-levers accomplishes this in a simple and effective manner. The construction and arrangement of circuit breakers or controllers is also an important feature, in that they maintain the circuit closed for very short periods of time, thus economizing battery power.

Having now stated the nature of our invention and the best manner of which we are aware in which the same is or may be carried into effect, what we claim is—

1. The combination, with the train of a time or regulating mechanism, of a stationary magnet having poles with curved faces, an armature for moving or impelling said train, pivoted at its center between and in line with the curved faces of the poles and limited in its movement about its center by stops, and intermediate pawl and locking mechanism, all as set forth.

2. The combination, with the train of a time or regulating mechanism, of a stationary electro-magnet having right-angled pole-pieces, an armature centrally pivoted between said poles and limited in its movement, and a pawl and locking mechanism operated by the movement of the armature for moving or impelling the train, as set forth.

3. The combination, with the wheel or train of an electric clock, of a stationary electro-magnet having right-angled pole-pieces, an armature centrally pivoted between said pole-pieces and limited in its movement, the said armature having projections extending along the sides of the pole-pieces of the magnet, and a pawl and locking mechanism between the armature and the train, whereby the movements of the said armature are imparted to the train, as set forth.

4. The combination, with the wheels or train of an electric clock, of an electro-magnet and armature, a pawl carried by the armature and engaging with one of the wheels, a locking-pin placed just beyond the normal limit of the movement of the pawl, and a pivoted lever having a pin that locks the wheel, the said lever being adapted to be raised by the armature through a portion of its path of movement, as set forth.

5. The combination, with the train of an electric clock, of an electro-magnet, an armature, a circuit containing said magnet, and a pendulum constructed and arranged for periodically making and breaking the said circuit, a pawl and locking mechanism for rotating the train step by step by the movement of the armature, and a weighted lever for impelling the pendulum, arranged to be raised by the upward movement of the armature, as described.

6. The combination, with a base-plate carrying a stud or arbor, of a pendulum and weighted lever connected with the arbor, a plate adjustably secured to the base-plate, a clock-train, and electro-magnetic impelling mechanism carried thereby, substantially as herein set forth.

7. The combination, with one of the wheels of a primary electric clock or regulator, of a circuit-controller for one or more secondary clocks, composed of a bar attached to a pivoted circuit-controlling lever, the said bar being adapted to be moved in the direction of its length by one or more pins on the said wheel and having a pin or projection that is brought by said movement into the path of a pin or projection on the train-impelling armature, whereby the bar is raised from engagement with the pin or stop on the wheel, as and for the purposes set forth.

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