(No Model.)

C. GULLBERG.

ELECTRIC CLOCK.

No. 260,751. Patented July 11, 1882.

Fig. 1.

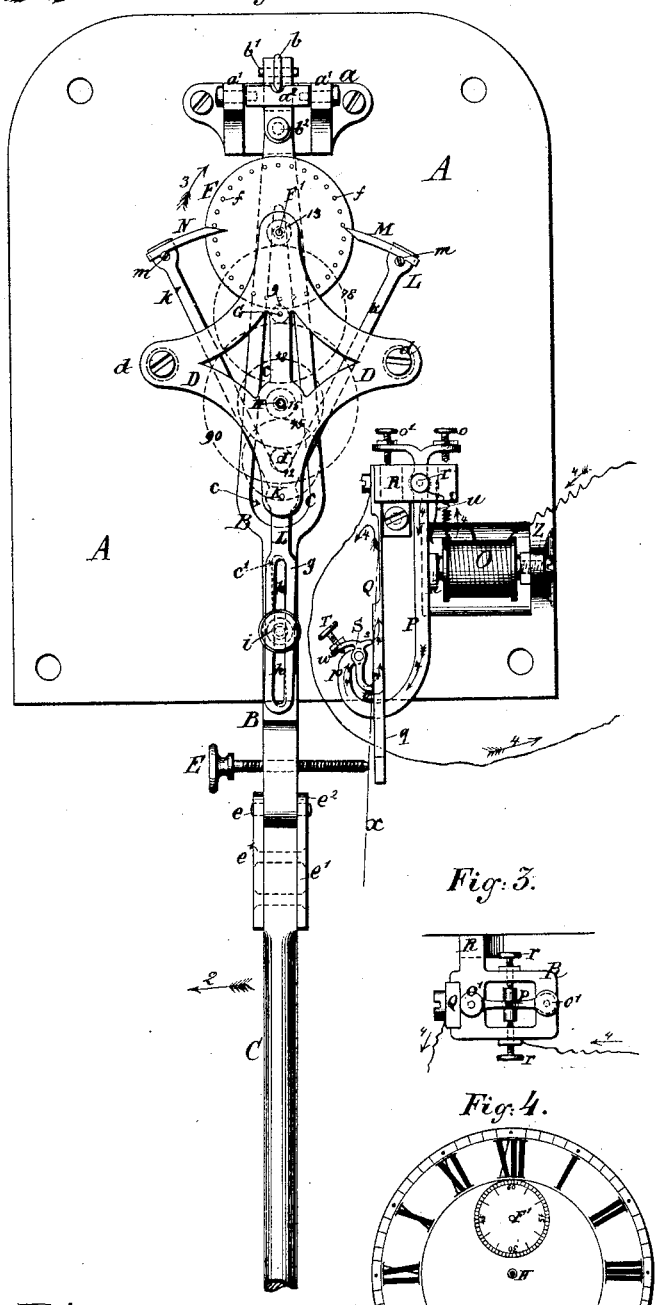

Fig. 2.

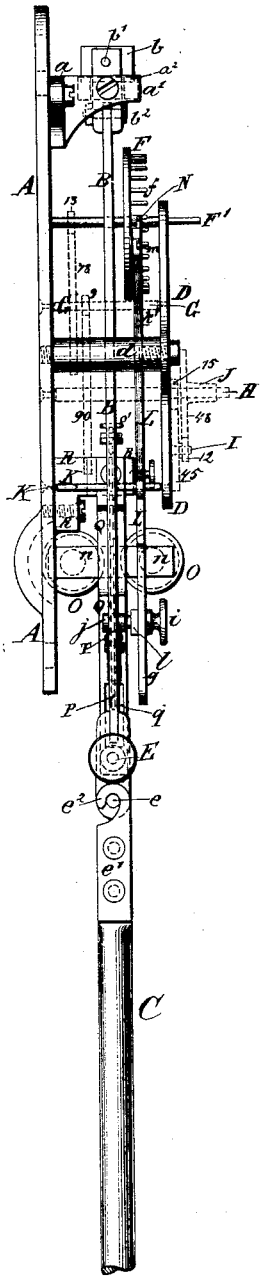

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

CARL GULLBERG, OF JERSEY CITY, NEW JERSEY.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 260,751, dated July 11, 1882.

Application filed August 22, 1881. (No model.)

To all whom it may concern:

Be it known that I, CARL GULLBERG, of Jersey City, in the county of Hudson and State of New Jersey, have invented a new and useful Improvement in Electric Clocks, of which the following is a specification.

My invention relates to clocks of that class in which winding-weights and coiled mainsprings are dispensed with and the motion of the pendulum is kept up by the aid of an electric current.

The object of the invention is to provide an improved electric clock of neat, compact, well-balanced, and durable construction, and in which the oscillation of the pendulum is not affected by a variation in the strength of the electric current, the liability of the electro-magnet to become gradually inoperative by corrosion at the point of making and breaking the current is entirely obviated or greatly diminished, the second wheel is driven entirely by stop and feed pawls from the pendulum, not merely escaping from the receding stop-pawl, as in other clocks where a wound spring in uncoiling turns the wheel, and the feed of the second wheel is effected by a very slight movement of the pendulum and is not affected by any variation of increase in the width of its oscillation.

In the accompanying drawings, Figure 1 represents a front elevation of my improved electric clock, the casing, dial, and indices being removed. Fig. 2 is a side view of the same, seen in direction of arrow 1. Fig. 3 is a detail plan view of the armature-bracket and the upper end of the armature-lever pivoted thereto. Fig. 4 is a face view of the dial-plate, drawn to a scale of one-fifth of the size corresponding to the other figures.

Like letters of reference indicate like parts in the several figures.

To simplify the appearance of the drawings, and thus facilitate examination of the construction, the train of gearing giving the proper proportion of speed between the indices of second, minute, and hour is indicated by dotted circles in Fig. 1 and dotted straight lines in Fig. 2. The combination in numbers of teeth in the several wheels and pinions, although generally immaterial so long as they produce the proper relative speed of the indices, will, however, be hereinafter stated, because their exact proportion, as here given, is essential for maintaining the inter-relative sizes and positions of dials and centers shown in Fig. 4, and the proper feed of the escapement or second wheel by a small (and even if at times variable and decreasing) width of oscillation of the pendulum, while allowing all movable parts to be rigidly fastened upon arbors of proper length, arranged in the center line of oscillation and supported at both ends, to insure durability, ease, and steadiness of motion.

The clock-work is mounted upon one common supporting-plate, A, attachable to the inside of the back of the clock-casing. To the middle of the plate A, at the upper end thereof, is fastened a bracket, *a*, having two horizontal arms, *a'*, between which is pivoted a rectangular gimbal, a^2, through which latter the upper end of the pendulum projects, and on which it it supported by the sharp edge of a steel plate, *b*, fastened by a pin, *b'*, in a cross-slot in the upper end of the pendulum, the plate *b* being oscillable upon the pin *b'* and resting with its end in ordinary fulcrum-pans upon the gimbal a^2 at either side, front, and back of the said upper end of the pendulum. By this construction the edge line of the steel plate *b* always remains evenly supported in horizontal position, and thus at right angles to the pendulum's plane of oscillation.

In order to secure that the center line of the pendulum, when at rest, shall fully coincide with the vertical center line of its angle of oscillation, (which it would not do if the slot for the plate *b* were not exactly vertical,) that portion of the pendulum to which the said plate is attached is made separate from the main portion and is pivoted thereto below the gimbal, at b^2.

The second-wheel and gear-wheels are all pivoted in the center line of the pendulum's angle of oscillation, thereby dividing the resistance evenly on either side of said center line. To allow of such arrangement the upper part, B, of the pendulum has a slot or opening, *c*, through which the arbors of the wheels are introduced before inserting their ends in their respective bearings in the back plate, A, and front plate, D, and securing the latter plate to the former by screw-studs *d*. The bar

B of the pendulum will thus occupy the position shown in Fig. 2 about midway between the plates A and D, with the arbors contained within the opening *c*. The opening *c* is widening downward, as shown in Fig. 1, according to the angle of the greatest oscillation of the pendulum, and is wide enough to allow that to take place freely without contact with any of the said arbors. A little below the opening *c* the bar B has another smaller axial slot, *c'*, of parallel sides, the object of which will presently appear. The bar B is flat and evenly thin from the pivot-joint b^2 to near its lower end, which is made thicker, and is bored through horizontally in the plane of oscillation and threaded to receive the thumb-screw E, whose object will presently appear. A pin, *e*, parallel with the screw E, is secured in a hole through the bar B at its extreme lower end, and projects from either side thereof.

The lower part, C, of the pendulum (which is not attached until the clock is fitted up for use) consists of an ordinary weighted rod, and has on two opposite sides of its upper end metallic plates *e'*, terminating with hooks e^2, which latter project above the rod and serve to suspend it upon the ends of the pin *e*, as shown in the drawings.

F is the second-wheel, from which motion is imparted to indicate minutes and hours by the following train of gear-wheels, which latter, for the sake of conciseness, are designated by figures, representing also the number of teeth in each: Pinion 13 on the arbor F' of the second-wheel gears with wheel 78 on arbor G. Pinion 9 on arbor G meshes with wheel 90 on arbor H. Pinion 15 on arbor H meshes with wheel 45, which, together with the pinion 12, is fastened upon a sleeve turning upon a stationary stud, I, on the front plate, D. Pinion 12 meshes with wheel 48, which is fastened upon a sleeve, J, running loose upon the arbor H of the minute-wheel. The hour-index is fastened upon the said sleeve J. All wheels and pinions not mentioned as "loose" are fast upon their respective arbors. This gearing, it will thus be seen, gives the proper relative proportion between the number of revolutions of the indices for the hour, minute, and second—namely, as the numbers 1, 12, and 720, respectively.

In ordinary clocks the train of gearing is moved by the gravity of a wound-up weight or the expansive force of a coiled spring, and the motion retarded by an oscillating pendulum or balance-wheel acting in connection with an escapement-wheel to time the movement of the second-wheel, and through the latter the movements of the remainder of the gear-wheels, the loss in motion at each oscillation being compensated by the said motive force acting through the escapement-pawl, which transmits its impetus to the pendulum or balance. In the present case the clockwork is operated entirely by the oscillation of the pendulum acting upon the second-wheel F, and the slight loss in motion at each oscillation is compensated by the elastic force of a spring which is set by the attraction of an electro-magnet on the closing of the circuit by the expansion of the said spring, and is released on the breaking of the circuit by the momentum of the pendulum, when the latter at the end of its return oscillation pushes the said spring from contact with the armature-lever of the electro-magnet. This is effected by the following mechanism:

On an arbor, K, pivoted to the plates D and A below the train of gear-wheels and in the center line of oscillation, is rigidly mounted a lever, L, which is bifurcated above the arbor, forming two upwardly-diverging arms, *k k'*, and has below the arbor a single arm, *g*, provided with an axial slot, *h*, corresponding with the slot *c'* in the bar B.

In the slot *h* is fitted a small sliding block, *l*, in which is threaded from the outside a thumb-screw, *i*, by which latter the block *l* may be clamped to the arm *g* after being adjusted in the slot *h* to the proper distance from the fulcrum K. On the inside the block *l* is provided with a small pin carrying a friction-roller, *j*, which is entered to work into the slot *c'* in the pendulum-bar B. From this it is evident that the oscillation of the pendulum will cause also the lever L to oscillate, giving a greater or less throw to the upper ends of the arms *k k'*, according as the block *l* is adjusted respectively nearer to or farther from the fulcrum K. The oscillation of the lever L rotates the second-wheel F by contact between the pins *f* (thirty in number) inserted at a right angle to the disk of the wheel F, and two pawls, M and N, formed on a circle arc with the arbor K for its center, which pawls are clamped by the heads of screws *m* in grooves formed in the ends of the arms *k k'*. The feed-pawls end with sharp points, formed by beveling the pawl N on its upper and the pawl M or its lower side.

The feed-motion is easily understood with reference to Fig. 1. The pendulum is supposed to be moving in direction of the arrow 2. The pawl N is entering and raises upon its inclined point the nearest tooth or pin *f*, while the pawl M recedes clear of its nearest pin *f*, on the upper side of which it then enters on the next oscillation, forcing it downward by contact with the bevel on the under side, thus causing the wheel F to move in the direction of the arrow 3. The pendulum being of proper length to oscillate once in a second, and two oscillations being needed to clear each of the thirty pins *f*, it follows that sixty oscillations will count sixty seconds and revolve the wheel F once.

It is evident that the leverage can be adjusted to cause a large throw of the pawls M N by a very small movement of the pendulum, and an increased throw of the latter would only cause the pawls to enter a little farther past their beveled ends in passing in between

the pins *f*, and thus only make a larger movement in the same space of time, while even with a very small motion of the pendulum they will enter far enough to feed. As a well constructed and suspended pendulum will oscillate for two hours or more by its own momentum merely, the above feature enables a person to detach, fix, and replace the working details pertaining to the electro-magnet without stopping the motion of the clock or causing it to lose time.

O is the electro-magnet, secured in a horizontal position to a lug, Z, upon the plate A. Its armature *n* is fastened to a pendent lever, P, pivoted in a rectangular opening in the bracket R upon two opposite screws, *r*, entering the said opening through the front and rear sides of the bracket, as shown in Fig. 3. Above the bracket R the upper end of the lever P has on opposite sides two lateral lugs or projections provided with adjusting set-screws *o o'*, which limit the throw of the oscillatory movements of the lower end of the lever by contact with the upper lateral end surfaces of the bracket R.

A flat, almost straight, spring, Q, facing the movement of the pendulum, is fastened by a screw through its upper end to the end of the bracket R nearest to the pendulum in such a manner that the lower end of the spring comes in juxtaposition to the end of the screw E, and gets in contact with the latter once for every other oscillation of the pendulum, the point of impact being determined and regulated by means of the said screw E. By the word "oscillation" is here meant the stroke or swing of the second-pendulum in one direction only, which in the present case is equivalent to one second of time, the pendulum making one stroke per second.

The spring Q has a slot, *q*, above its place of contact with the screw E, and the lower end of the lever P has an upward recurved termination, *p*, which is passed through the slot *q*, and serves as pivoting-point for a small double-contact lever or pawl, S, having two toes, *s* and *v*, the latter and lower toe, *v*, being much longer than the former.

The slot *q* is of sufficient width to prevent any contact between the spring Q and lever P, except by means of the pawl S, when the latter impinges upon the spring Q above the slot *q* on the closing of the current. The pawl S has above its pivots a little bent lug, *w*, through which is fitted an adjusting set-screw, T, which, by contact with the upper surface of the recurved lever end *p*, limits the forward throw of the long toe *v* of the pawl S.

Referring to the position of parts in Fig. 1, the co-operation of the magnet, spring, and pendulum is as follows: The pendulum is moving in direction of arrow 2 after having received from the pressure of the spring Q a slight impulse, just only strong enough to compensate for the very slight loss in motion due to gravity and friction during one oscillation. The spring having expanded into about the position indicated by the line *x*, and by contact with the pawl S re-established the electric current, is bent back or "set" and kept so by the force of the magnet O attracting the armature *n*. On the return oscillation of the pendulum the point of the screw E touches the spring Q, just to separate it from the pawl S, and thus break the circuit; the magnetic force ceases; the little spring *u*, attached to the bracket R, pushes on the side of the lever P, thereby moving its lower end, with its pawl S, as far away from the spring Q as the stop-screw *o* will allow; the pawl S, released from the spring Q, is turned by gravity a little on its pivot to project the lower toe, *v*, as far as the stop-screw T will allow, and the spring Q, expanding to resume its normal shape, presses against the end of the screw E, impelling the pendulum in the direction of arrow 2. At the end of its expansion the spring Q again touches the toe *v* and closes the electric circuit, and the iron rods in the coils O become magnetic and attract the armature *n*, thereby resetting the spring Q and resuming the position shown in Fig. 1. As the spring in expanding first strikes the toe *v*, the latter has to slide upon the surface of the spring, while the pawl S turns upon its pivot enough to bring also the upper short toe, *s*, in contact with the spring, and while the lever P, attracted by the magnet, swings toward the latter against the tension of the spring Q, both toes *s* and *v* of the pawl S are caused to slide on the spring, thereby constantly keeping its surface and the toe-points clean and free from corrosion. To trip the pawl S, a small spring instead of gravity may be used, and to trip the lever P a weight attached, for instance, to a projection from the lug of the stop-screw *o* may be used instead of the spring *u*.

The stop-scew *o'* is to prevent the armature *n* from impinging upon the end of the electro-magnet, which it should all but touch, for in that case it might be held with such force as to render it insufficiently sensitive in relaxing on the breaking of the circuit.

The bracket R is made of rubber or otherwise insulated, so that the current cannot pass over from the lever P to the spring Q, except by way of the pawl S. The current when the circuit is closed is indicated by arrows 4.

It is evident that any electro-magnetic force sufficiently strong to set the spring Q will operate satisfactorily, and its greater or less strength has no no influence whatever on the pendulum.

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

1. The combination of the clock-train arbors F' G H, and the arbor K of the stop and feed lever L, all arranged in the center line of the pendulum angle of oscillation within a slot or opening, *c*, through the upper part, B, of the pendulum, substantially as specified.

2. In combination with the pendulum and with the second-wheel F, having pins *f* secured to its circular surface, the bifurcated stop and feed lever L, provided with pawls M N, constructed as described, said lever receiving its motion directly from the pendulum, substantially as specified.

3. In combination with the wheel F, having pins *f* upon its surface, and with the pendulum having slot *c'*, the bifurcated lever L, having feed-pawls M N and slot *h*, and also provided with an adjustable pin securable in the said slot and working in the slot *c'* of the pendulum, substantially as and for the purpose set forth.

4. In combination with the gimbal a^2, the pendulum provided with the pivoted supporting edge-plate *b*, a pivotal joint, b^2, below the said gimbal, a slotted bar, B, straddling the train-arbors below the said joint, and a weighted rod, C, arranged to hook onto the lower end of the said bar B, all constructed substantially as and for the purpose set forth.

5. The combination of the clock-pendulum, the adjustable contact-screw E, secured to the said pendulum, the impulsion-spring Q, having uniform working-surface, without pawl, and being secured in an upright position at a distance from the pendulum's center line of oscillation, as shown, and the adjustable lever P of the electro-magnetic armature, said lever being pivoted in pendent position between the said spring and magnet, parallel with the spring and pendulum, to make and break the circuit by respective contact and release from contact with the said spring, substantially as herein shown and described.

6. In combination with the spring Q, actuated by the pendulum, and the armature *n*, actuated by the electro-magnet, the suspension-lever P, carrying a pivoted sliding pawl, S, having two toes, *s v*, for making and breaking circuit-contact with the said spring, substantially as and for the purpose set forth.

7. In combination with the spring Q, actuated by the pendulum, and the armature *n*, actuated by the electro-magnet, the suspension-lever P, with curved lower end going through a slot, *q*, in the said spring, and the lever-pawl S, pivoted to the recurved end *p* of the lever P, and provided with two toes, *s v*, of different length, and adjusting stop-screw T, substantially as and for the purpose specified.

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