(No Model.) 2 Sheets—Sheet 1.

A. S. CRANE.

SECONDARY ELECTRIC CLOCK.

No. 286,181. Patented Oct. 9, 1883.

Fig. 1.

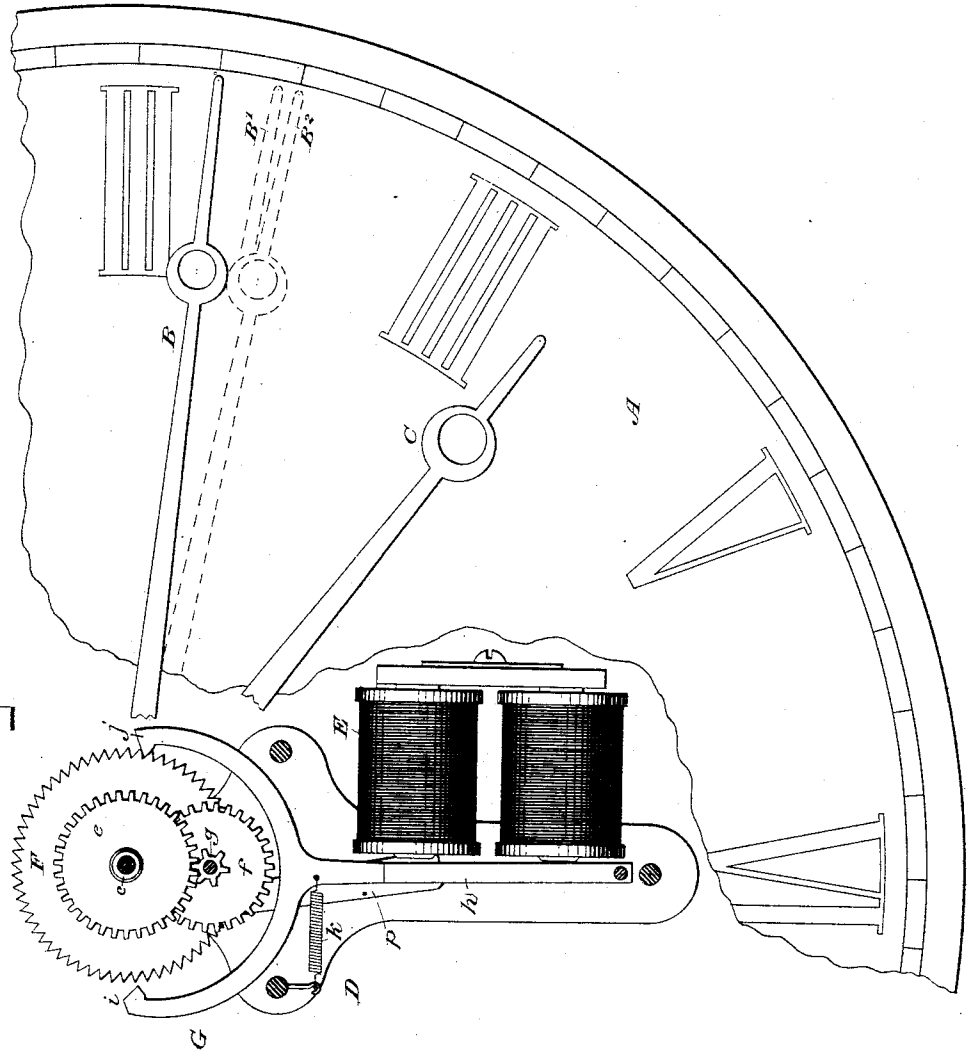
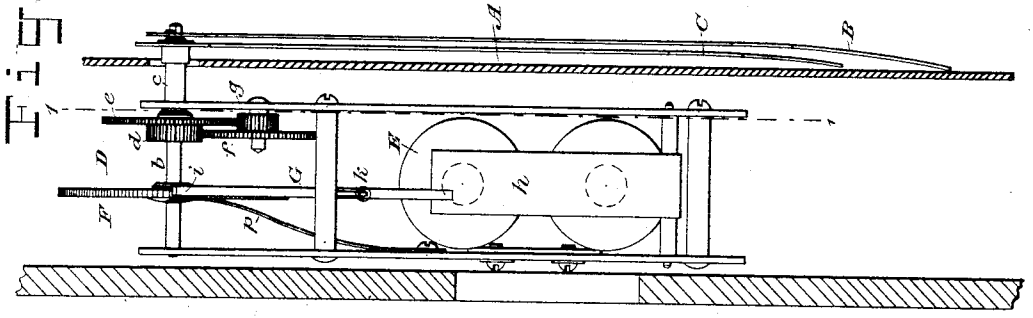


Fig. 2.



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Fig. 3.

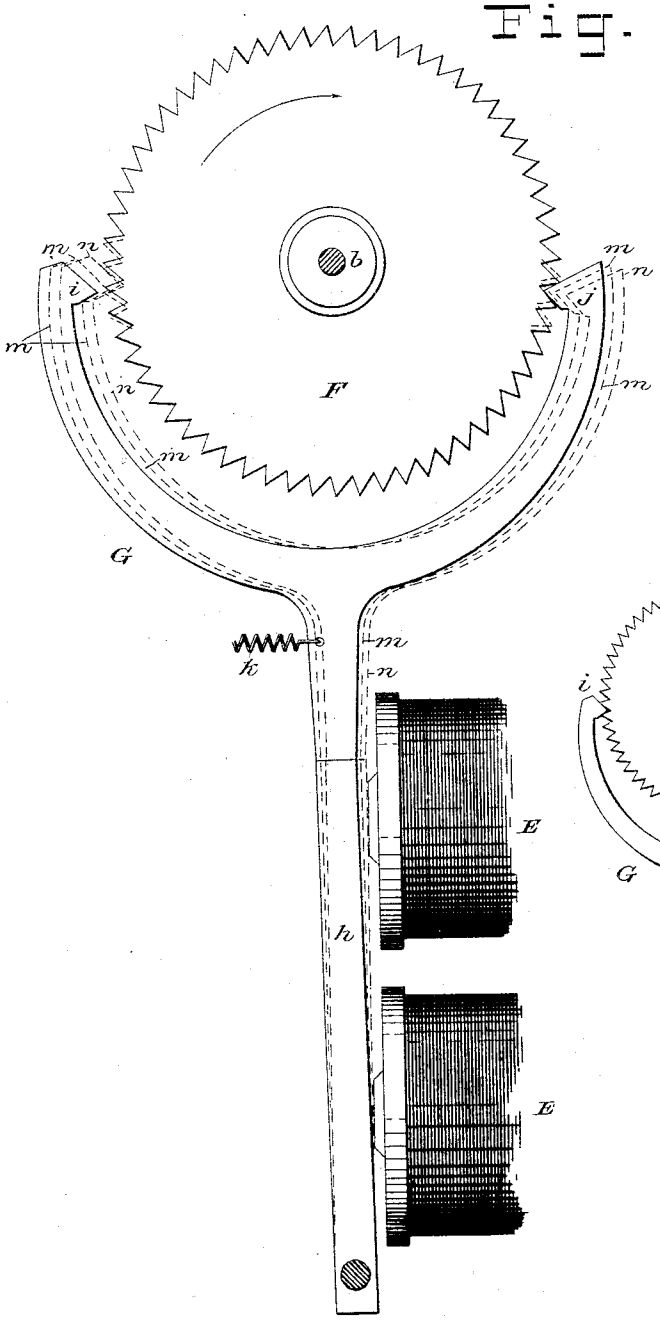
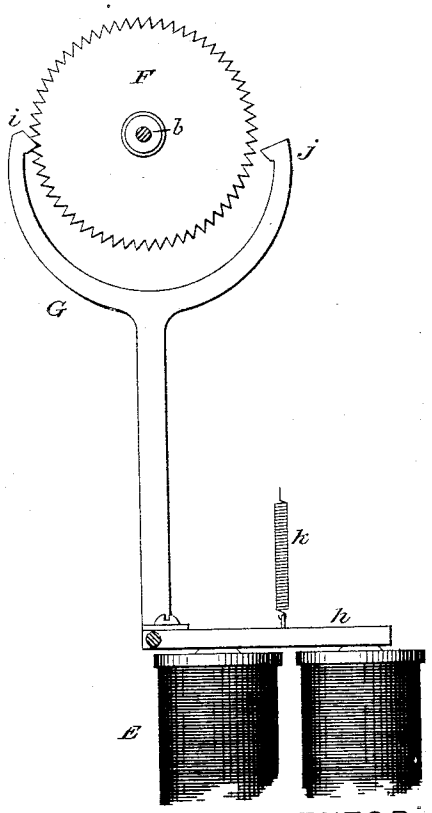


Fig. 4.



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UNITED STATES PATENT OFFICE.

AUGUSTUS S. CRANE, OF NEWARK, NEW JERSEY.

SECONDARY ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 286,181, dated October 9, 1883.

Application filed May 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTUS S. CRANE, a citizen of the United States, residing in Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Secondary Electric Clocks, of which the following is a specification.

In transmitting time telegraphically it is customary to arrange, in connection with an electric circuit, one primary clock and a number of secondary clocks. The primary clock is an accurately-adjusted regulator working a circuit-manipulating device which is arranged to close and break (or break and close) the line-circuit at intervals of one minute, (or of one second, as the case may be.) The secondary clocks each consist of a dial with hour and minute or with hour, minute, and second hands, operated intermittently through suitable reducing-gears by an electro-magnet installed in the circuit. It is to these secondary clocks that my present invention relates. As these clock have been heretofore constructed the train has been advanced intermittently at each impulse through the medium of a ratchet-wheel and pawl, the pawl being vibrated against the ratchet-wheel by the armature of the magnet in such manner that the ratchet-wheel has been caused to advance the distance of one tooth at each impulse over the line. For a clock with no second-hand the ratchet-wheel is fixed on the minute-arbor and has sixty teeth, the usual dial-wheels being used to impart a slower motion to the hour-hand. Clocks thus constructed are undesirably complicated, and in practical use are not reliable in their action, being found to occasionally lose a minute.

The object of my invention is to produce a clock which shall be reduced to the extreme of simplicity and compactness in its construction, which shall be certain and reliable in its operation, and which shall require the minimum of electro-magnetic power to operate it.

Figure 1 of the accompanying drawings is a front elevation of a portion of a secondary clock constructed according to my invention, the dial being broken away to show the movement, and the latter being in vertical section cut in the plane of the line 1 1 in Fig. 2. Fig. 2 is a vertical mid-section of the case and dial and a side elevation of the movement. Fig. 3 is an enlarged fragmentary front elevation; and Fig. 4 is a fragmentary front elevation on the same scale as Fig. 1, showing a modification.

Referring to Figs. 1 and 2, let A designate the dial, B the minute-hand, C the hour-hand, D the clock-movement behind the dial, and E the electro-magnet. The minute-hand B is mounted on the minute-arbor *b*, which passes through the tubular hour-arbor *c*, on which the hour-hand C is mounted. On the arbor *b* is a pinion, *d*, communicating reduced motion to a gear-wheel, *e*, on the arbor *c* through dial-wheels *f g*, in the usual way. On the arbor *b* is fixed a toothed wheel, F, in the nature of an escapement-wheel, having sixty angular teeth. (Shown best in Fig. 3.) This wheel takes the place of the ratchet-wheel heretofore used in secondary electric clocks.

The armature *h* of the magnet E is, in the preferred form of my invention, arranged vertically, being pivoted or fulcrumed at its lower end, and from its upper end springs an anchor, G, the two forming one continuous lever. This anchor G is forked, and its arms extend to opposite sides of the wheel F and terminate in propelling-pallets *i* and *j*, of wedge shape. The retracting-spring *k* engages the anchor or armature and tends to draw the anchor to one side, so that its pallet *j* shall enter between two teeth of the wheel F, as shown in Figs. 1 and 3. The electro-magnet acts upon the armature in the opposite direction, and when excited draws the anchor to the opposite side, so that its pallet *i* engages the teeth of the wheel F, as seen in Fig. 4.

It is usual to work these clocks upon an open circuit which is closed at intervals of a minute, each closure enduring for nearly a second. While the circuit is open the parts are in the positions shown in Figs. 1 and 3, the pallet *j* holding the wheel F stationary. Upon the closure of the circuit the anchor is vibrated to the right, so that the upper inclined surface of the pallet *i* strikes the point of one of the teeth on the wheel F and pushes it upward, thereby slightly rotating the wheel. When the current ceases, the spring *k* draws the anchor back, causing the pallet *i* to free itself and the pallet *j* to enter between two teeth and

move the wheel a further distance, the sum of the two movements being one-sixtieth of the circumference of the wheel, and hence advancing the minute-hand a distance of one minute on the dial.

It will be observed on reference to Fig. 3 that while at rest the pallet *i* clears the ends of the teeth of the wheel F by a distance equal to nearly or about one-half of its entire play, so that in being drawn toward the right by the attraction of the magnet it moves half the total distance before encountering the tooth which it is to act upon and move upward. At the instant of encountering this tooth it is in the position denoted by the dotted outline *m m*. By this arrangement the anchor has no work to do during the first half of its stroke, and so acquires considerable momentum before striking the tooth, the mechanical resistance encountered in moving the toothed wheel being then overcome with greater ease, owing to the closer proximity of the armature to the poles of the magnet than at the commencement of the stroke.

Anchors having propelling-pallets have been used in primary electric clocks—as, for instance, in the clock embodied in my application for patent filed January 26, 1883—but wherever heretofore used they have been arranged to advance the toothed wheel the distance of half a tooth at each movement of the anchor from one side to the other. This is desirable with a wheel having thirty teeth, when the anchor is vibrated by two oppositely-acting electro-magnets excited alternately at intervals of a second, as in the clock shown in my said application, or at intervals of a minute; but it is undesirable in a secondary clock operated by one magnet excited once each minute or second, as it necessitates dividing the work equally between the magnet and the retracting-spring and advances the hand only half a division on the dial upon the closure of the circuit, whereas it is desirable that the hand should be advanced as nearly as possible to one division, so that the movement upon the breaking of the circuit will be nearly imperceptible. It is impossible to construct an anchor with propelling-pallets which shall advance the wheel the entire distance between two teeth at one movement in either direction; but in my clock I arrive as closely as is practicable to this desideratum, as will be seen from an inspection of Fig. 3. Here the anchor and wheel are shown in full lines in their normal position, and in dotted lines in the position maintained during the time that the armature is held attracted to the magnet, the dotted lines *n n* being the ones illustrating this position of the anchor. It will be observed that the pallet *i* is so formed that it imparts almost the entire impulse, or, in other words, that it moves the wheel considerably farther than half the distance from one tooth to the next, the precise proportion which I have adopted being four-fifths of this distance, leaving the pallet *j*, on the retracting-stroke, to impel the wheel only one-fifth of a space. The effect upon the hand B may be noted in Fig. 1, where the dotted line B′ denotes the position to which the minute-hand will move from the position shown in full lines upon the next closure of the circuit. It will remain in this position during the time (usually nearly one second) in which the circuit remains closed, and upon the breaking of the circuit it will advance to the position shown at B^2, where it will remain during the ensuing fifty-nine seconds.

By referring to Fig. 3 the pallet *i*, when in the position shown by dotted line *m*, has its point just beneath the point of one of the teeth. When the wheel has rotated four-fifths of a space, the point of the next tooth is just beneath the position occupied by the point of the pallet at *m*. The remaining one-fifth of a space to be traversed by the teeth under the impulse of a pallet, *j*, is necessary to insure that the pallet *i*, in its next impelling-stroke, shall enter beneath the tooth. By making this final movement one-fifth of a space, I secure a clearance for this pallet of one-tenth of a space on each side, which is quite sufficient to insure the accurate working of the clock.

By constructing the pallet *i* to impart the greater portion of the movement to the wheel F, I secure the advantage of accomplishing nearly the entire work by the direct action of the magnet, instead of employing the magnet to distend a spring and then requiring the contraction of the spring to do the necessary work. In this way I utilize the energy of the magnet to the best advantage and increase the certainty of operation of the clock, so that by the simple expedient of increasing at the central office the power of the battery on the line all the clocks in circuit may be energized to any desired extent, and thus rendered capable of overcoming any possible mechanical resistance. This capability is especially desirable for calendar-clocks, which are subject to an increased mechanical resistance at midnight, and at the end of each month on the occasions of their advancing the calendar-indicator; but in ordinary use my clocks require less battery-power than any secondary clocks heretofore made, so far as I am aware.

In order to guard against any possible displacement of the wheel F during the movement of the anchor from one extreme to the other, which might be sufficient to cause the point of the pallet *i* to engage the wrong side of a tooth, and so impel the wheel backward instead of forward, I provide a slender leaf-spring, *p*, to press lightly against the back of the wheel F, as shown in Fig. 2. It is not necessary that this spring develop any appreciable friction, its sole purpose being to take up any looseness which might permit the wheel to be jarred slightly backward by the vibration of the building or other extraneous cause.

In Fig. 1 the electro-magnet is arranged horizontally, while in Fig. 4 it is shown as arranged vertically. The former arrangement is pref-

erable for its greater compactness, making the movement applicable to clocks with small dials. It will be observed that in either case the magnet is arranged with the axes of its cores parallel to the plane of the clock-dial, and its armature is fulcrumed at one end on a pivotal axis extending horizontally and at right angles to the axes of the cores and to the plane of the dial. This arrangement of the motive parts insures the utmost compactness, and enables the use of a shallow case, or one that projects but slightly from the wall, which is highly desirable.

I claim as my invention—

1. In a secondary electric clock, the combination of electro-magnet E, armature *h*, retracting-spring *k*, anchor G, propelling-pallets *i* and *j* thereon, toothed wheel F, and a suitable train for driving the hands from said wheel when the pallet *i*, which engages the wheel F while the armature is moving toward the magnet, is formed to impel the wheel forward nearly the entire distance between two teeth, and the pallet *j*, which engages the wheel during the retraction of the armature, is formed and adapted to impel the wheel the slight remaining portion of said distance and to hold it there until the next attraction of the armature, substantially as and for the purposes set forth.

2. The combination, to form a secondary electric clock, of dial A, electro-magnet E, arranged with the axes of its cores parallel to the plane of the dial, armature *h*, fulcrumed on an axis crossing it at one end, and said axis extending at right angles to the axes of the cores and to the plane of the dial, retracting-spring *k*, anchor G, fixed to said armature, propelling-pallets *i* and *j* thereon, toothed wheel F, minute-arbor *b*, hour-arbor *c*, and train *d*, *e*, *f*, and *g*, all arranged to operate substantially as set forth.

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

AUGUSTUS S. CRANE.

Witnesses:
ARTHUR C. FRASER,
GEO. BAINTON.