(No Model.) 4 Sheets—Sheet 1.

E. G. HAMMER.

SELF WINDING ELECTRIC CLOCK.

No. 527,786. Patented Oct. 23, 1894.

FIG. 2.

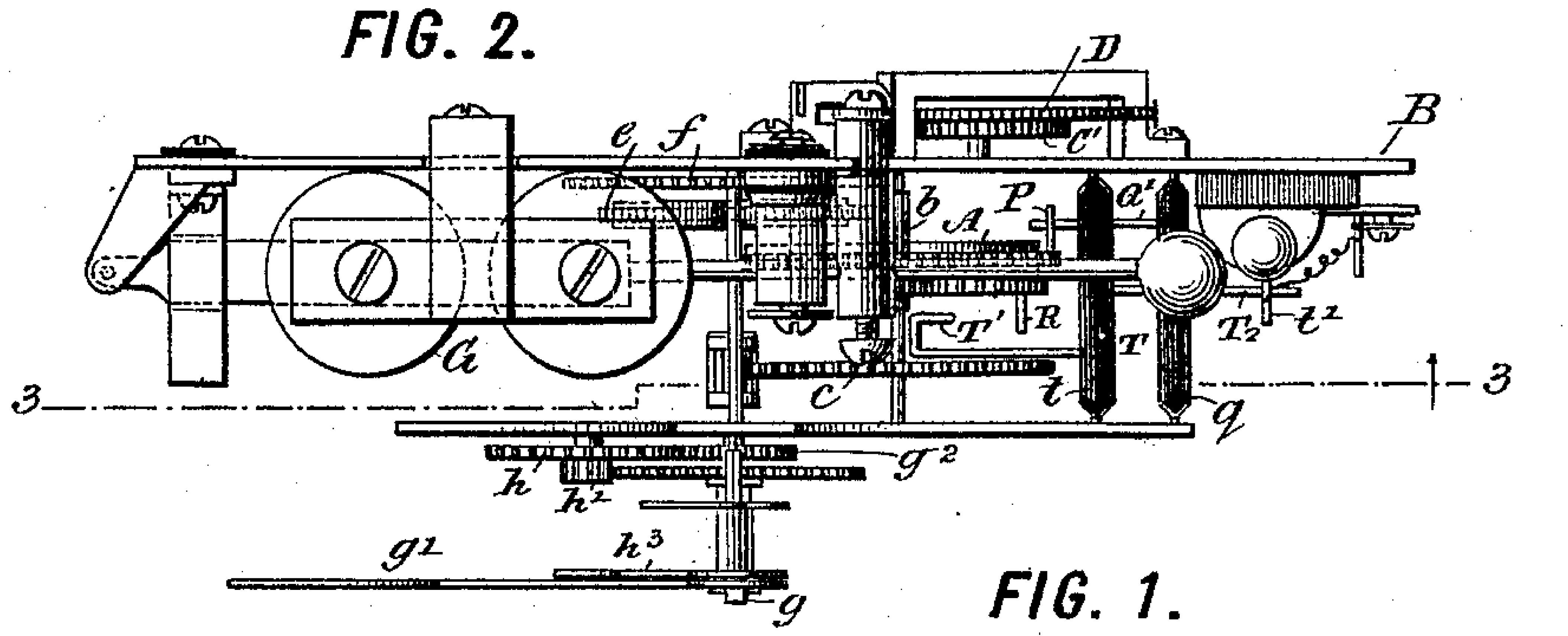
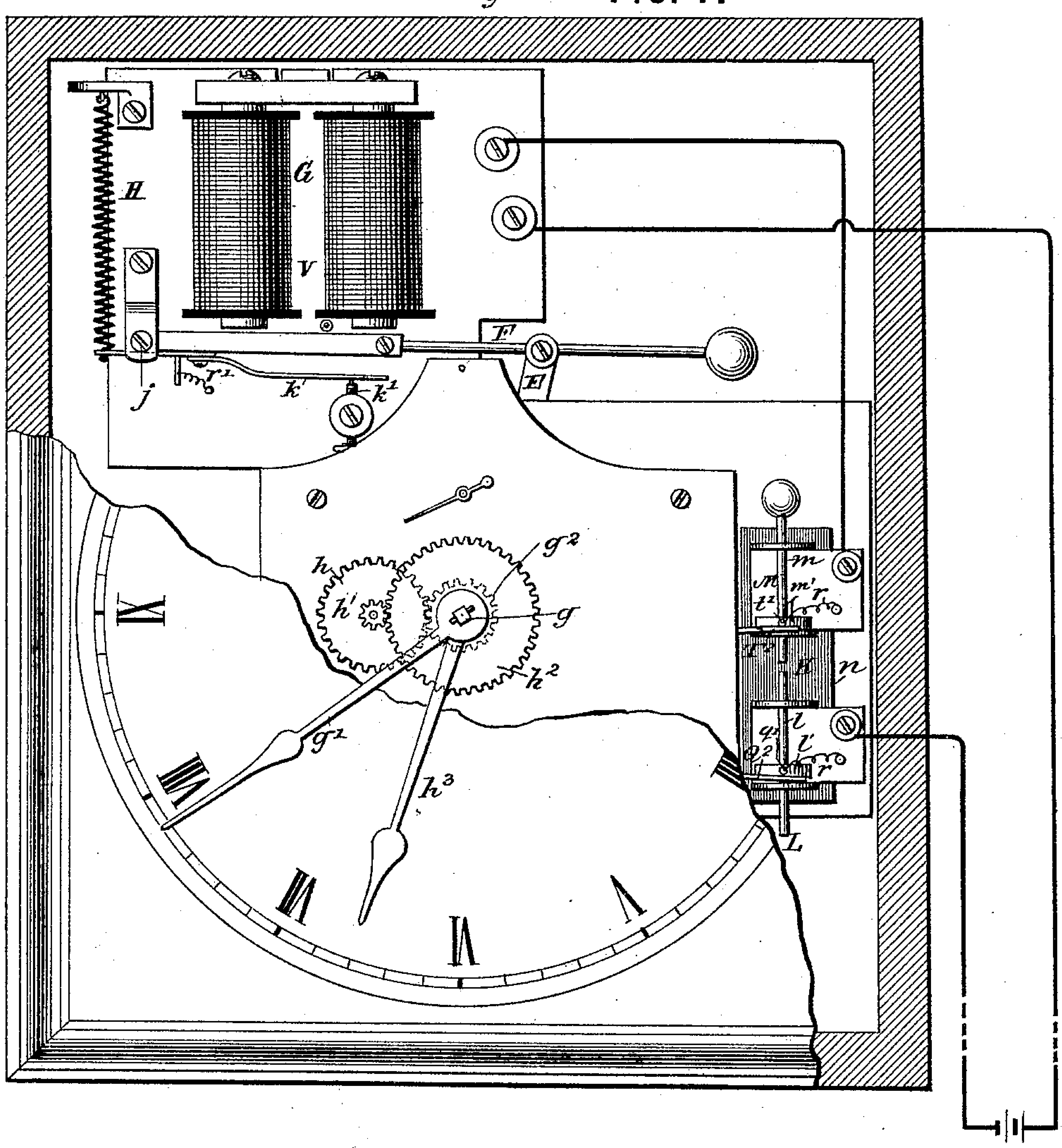


FIG. 1.



WITNESSES:

Fred White

C. K. Fraser.

INVENTOR:

Emil G. Hammer,

By his Attorneys,

Arthur C. Fraser & Co.

(No Model.) 4 Sheets—Sheet 2.

E. G. HAMMER.

SELF WINDING ELECTRIC CLOCK.

No. 527,786. Patented Oct. 23, 1894.

FIG. 3.

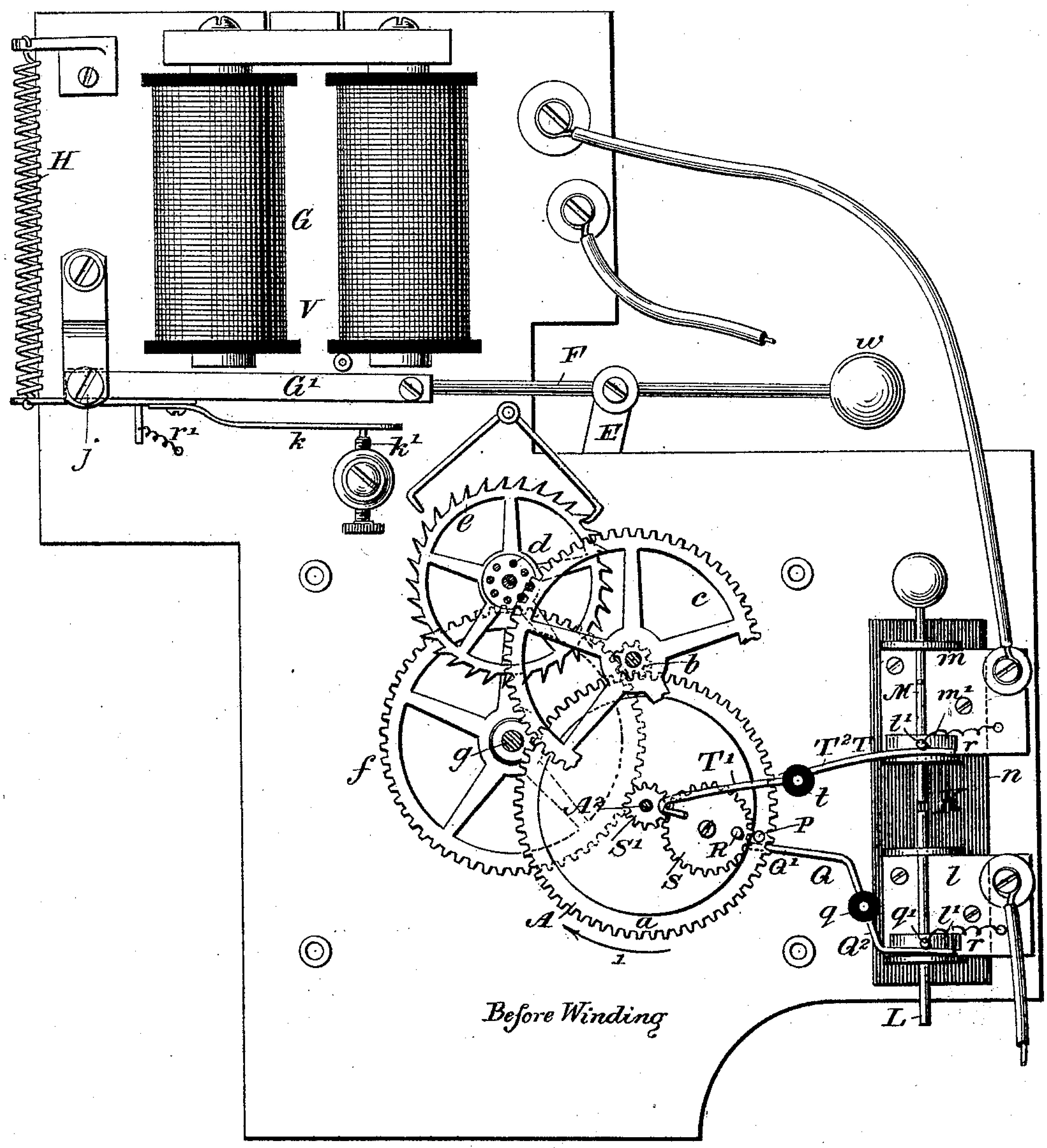
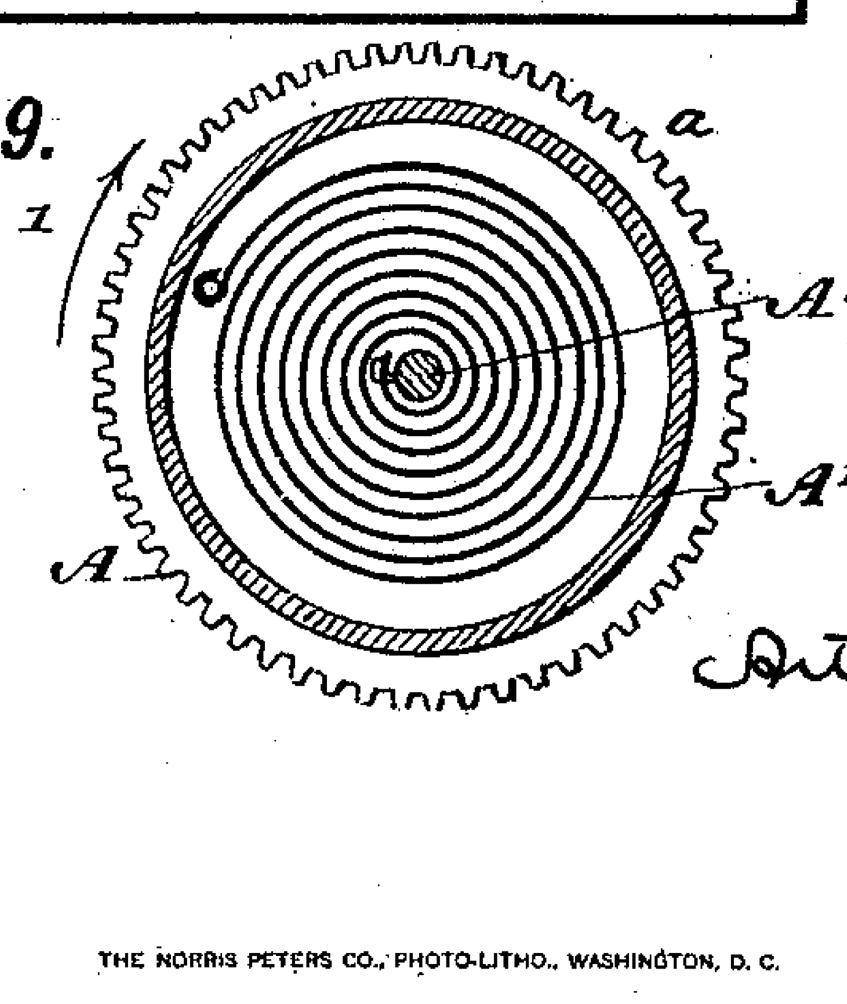


FIG. 9.



WITNESSES:

Fred White

C. K. Fraser.

INVENTOR:

Emil G. Hammer,

By his Attorneys,

Arthur C. Fraser & Co

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 3.

E. G. HAMMER.

SELF WINDING ELECTRIC CLOCK.

No. 527,786. Patented Oct. 23, 1894.

FIG. 4.

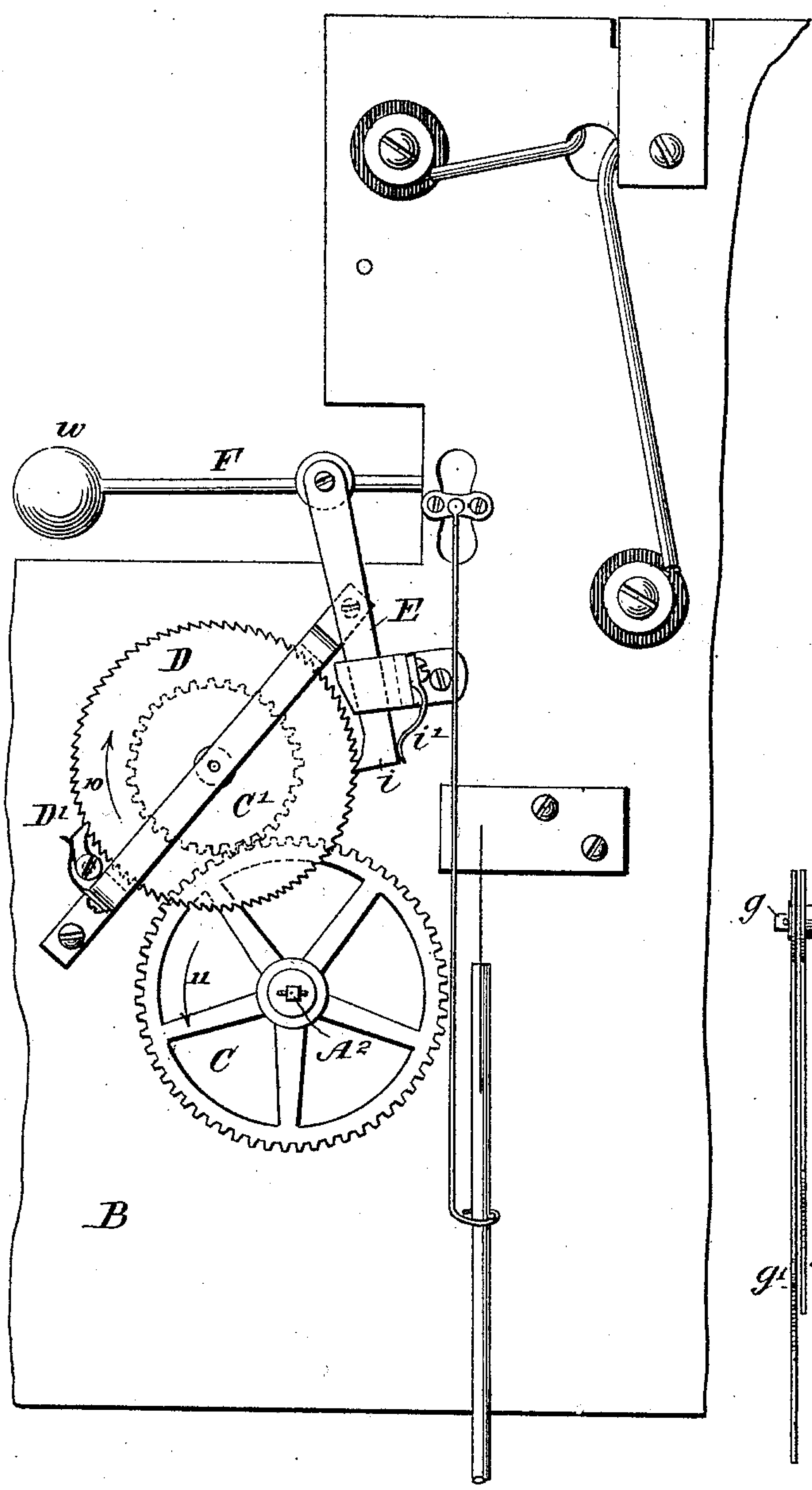
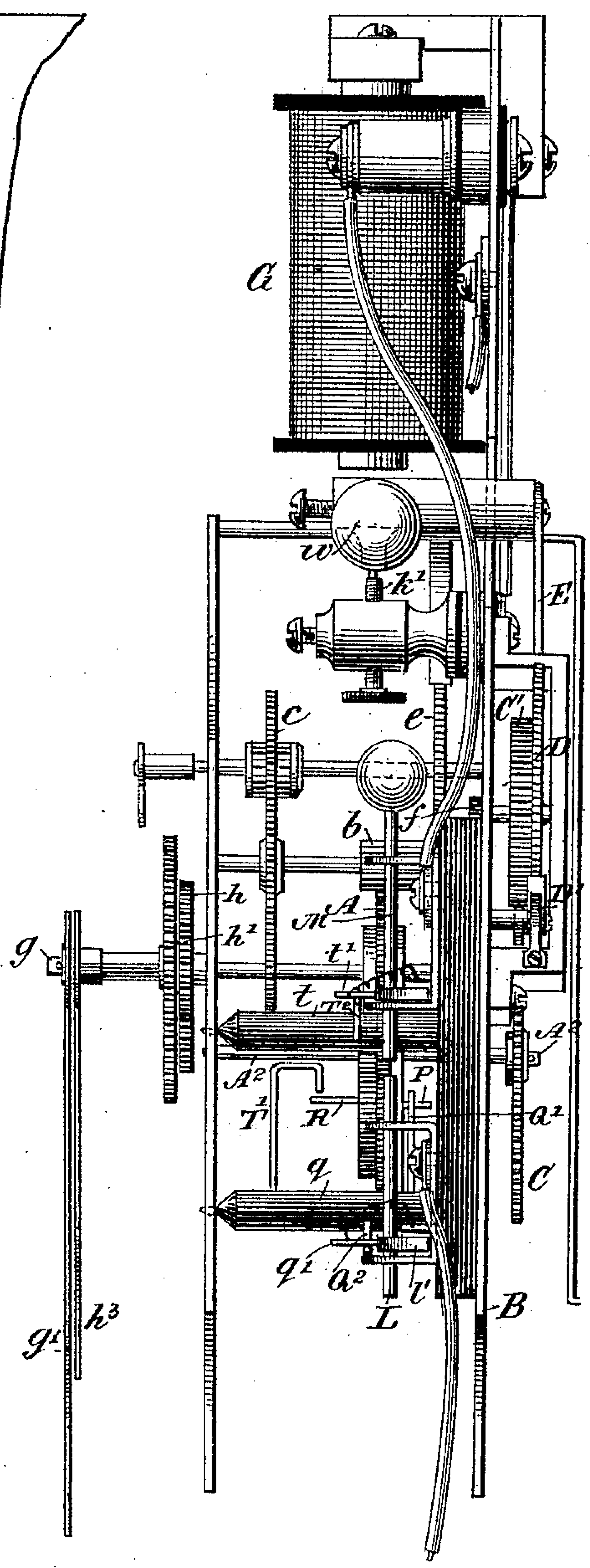


FIG. 5.



WITNESSES:

Fred White

C. K. Fraser.

INVENTOR:

Emil G. Hammer,

By his Attorneys,

Arthur C. Fraser & Co.

(No Model.)

4 Sheets—Sheet 4.

E. G. HAMMER.

SELF WINDING ELECTRIC CLOCK.

No. 527,786. Patented Oct. 23, 1894.

FIG. 6.

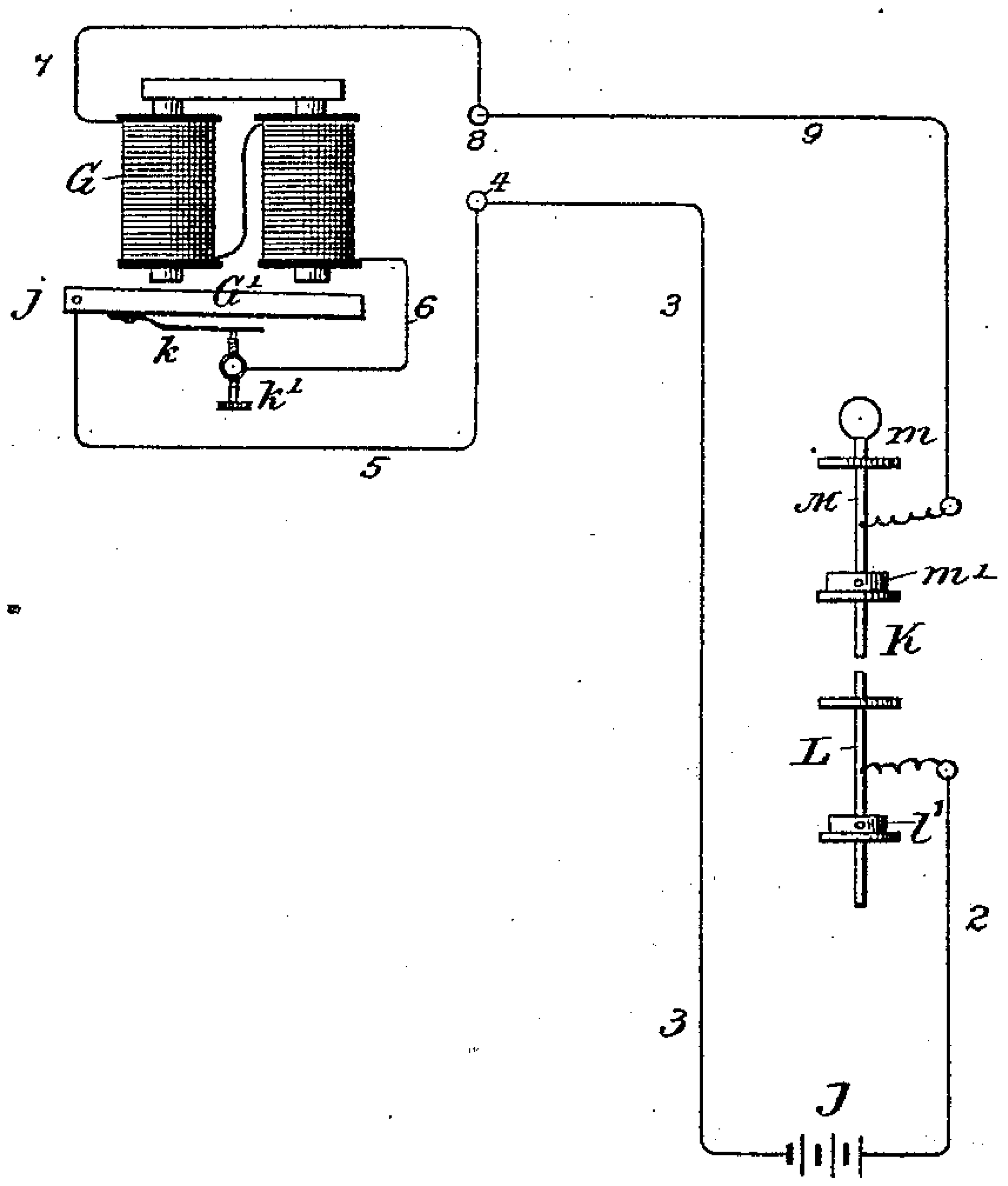
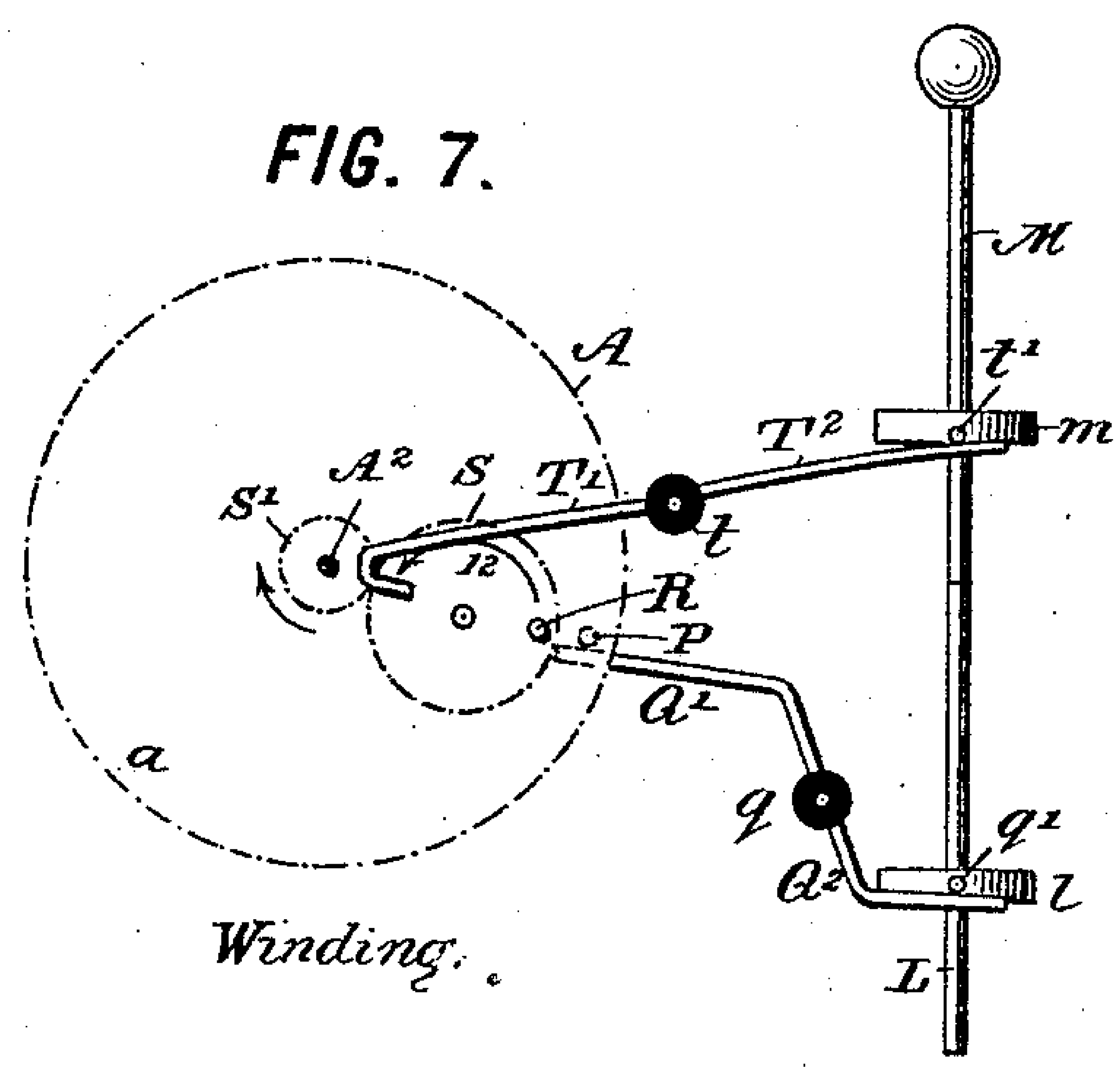
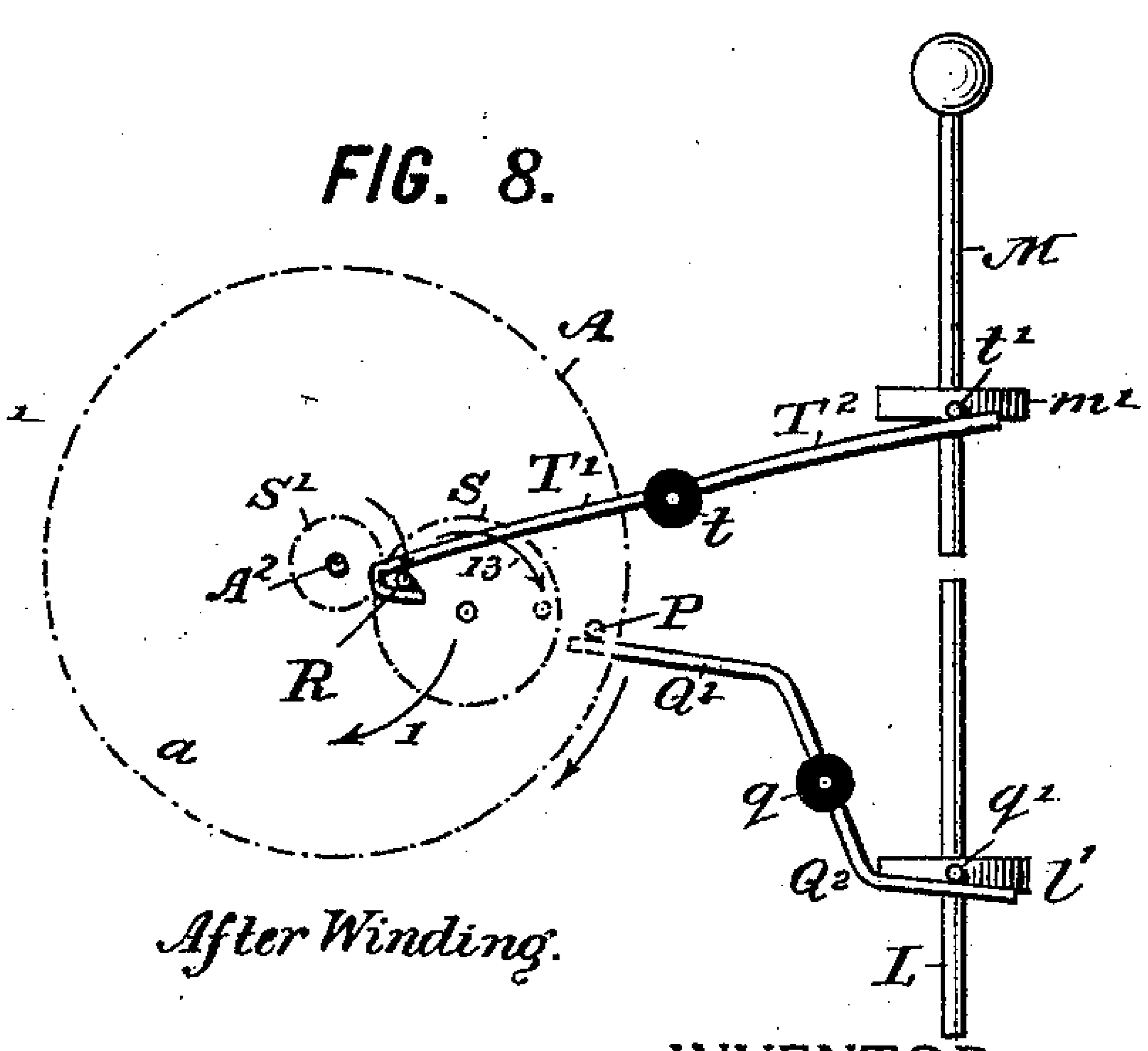


FIG. 7.



Winding.

FIG. 8.



After Winding.

WITNESSES:

Fred White,

C. K. Fraser.

INVENTOR:

Emil G. Hammer,

By his Attorneys,

Arthur C. Fraser & Co.

UNITED STATES PATENT OFFICE.

EMIL G. HAMMER, OF BROOKLYN, NEW YORK.

SELF-WINDING ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 527,786, dated October 23, 1894.

Application filed July 18, 1893. Serial No. 480,825. (No model.)

To all whom it may concern:

Be it known that I, EMIL G. HAMMER, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Self-Winding Clocks, of which the following is a specification.

This invention relates to clocks which are driven by a spring or weight and provided with electrical means for re-winding the spring or weight at stated intervals. The invention aims to produce a cheap and reliable self-winding timepiece that shall be simple in construction, positive in its action, and not liable to get out of order. Instead of using an electro-motor for winding up the spring or weight by a rotative action, my invention provides an electric vibrator or rheotome which is set in vibration at proper intervals, and which operates through the medium of a pawl and ratchet to effect the requisite rotary motion for winding up the spring or weight.

My invention also provides an improved construction of circuit-closing or breaking device by means of which the electro-motive means for rewinding the clock is set into operation, and is stopped at the end of its operation.

My invention also provides an improved mechanical movement in connection with a clockwork for automatically operating the circuit closer and breaker to insure the proper timing of the operation of the rewinding mechanism.

I will proceed to describe the preferred construction of my invention with reference to the accompanying drawings, wherein—

Figure 1 is a front elevation of my improved clock with its dial and case front partly removed to show the interior mechanism. Fig. 2 is a plan of the interior mechanism. Fig. 3 is a front view on a larger scale of the interior mechanism partly in section, cut just back of the front plate thereof, as denoted by the line 3—3 in Fig. 2. Fig. 4 is a fragmentary rear view on the same scale as Fig. 3. Fig. 5 is a side elevation looking from the right in Fig. 3, or from the left in Fig. 4. Fig. 6 is a diagram showing the circuit connections. Figs. 7 and 8 are fragmentary detail views on the same scale as Fig. 3, showing the circuit controlling mechanism in two different positions. Fig. 9 is a sectional view of the spring barrel.

Referring to the drawings, let A designate the spring barrel inclosing a coiled spring A′, the outer end of which is attached to the barrel, as shown in Fig. 9, while its inner end is attached to an arbor A^2, which is the winding arbor. The exterior of the barrel A is formed with gear-teeth *a*, or has fixed to it a gear-wheel, these teeth meshing with a pinion *b* fixed on the same arbor with a gear-wheel *c*, which in turn meshes with a pinion *d* fixed on the arbor of the escape-wheel *e* of the escapement. The same pinion *b* also meshes with a wheel *f* on the minutes arbor *g*, which projects through the front of the case and carries the minute hand *g′*. On this arbor is fixed a pinion g^2 (Fig. 1) which through the usual reducing gears *h*, *h′*, h^2 imparts reduced motion to the hour hand h^3.

It is to be understood that any other arrangement of gearing known in the art may be substituted for the particular gearing shown, as this forms no part of my invention.

Preferably the wheels *f* and *a* have a like number of teeth, so that since they both mesh with the same pinion *b*, they both revolve in equal time, so that the spring barrel A turns or runs down to the extent of one revolution in one hour. Other proportions, however, may be adopted so that it will execute a greater or less movement each hour. With the proportions shown the clock is designed to have its spring rewound at the end of each hour, but with different proportions it may be wound at longer or shorter intervals of time as may be desired.

The mechanism thus far described is simply an ordinary clock mechanism driven from a spring barrel, the latter being so constructed that the spring may be rewound without displacing the barrel by simply turning the winding arbor A^2 in forward direction, that is, in the same direction as the arrow 1 in Fig. 3 or 9. In an ordinary clock this arbor would be turned by a key, and held against revolving backward by a ratchet and pawl. In my improved self-winding clock this arbor is turned forward one complete revolution at the end of each hour (or other predetermined interval of time) by the mechanism which I will now describe.

The arbor A^2 passes through the back plate B of the mechanism frame, and has fixed on its projecting end, as shown in the rear view Fig. 4, a gear-wheel C. This meshes with a gear C′ fixedly connected to a ratchet-wheel D having preferably fine teeth. This ratchet-wheel is engaged by a stop-pawl D′ to prevent back motion, and is propelled by a pawl E which is connected to the electric vibrator or rheotome, which as a whole is lettered V. In the construction shown the pawl E consists of a light bar formed at one end with a tooth or nose *i* for engaging the teeth of the ratchet-wheel, and pressed toward it by a spring *i′*, while at its other end it is pivoted to a vibratory lever lettered F of the vibrator V. This lever F constitutes the armature-lever of the vibrator, and is pivoted at *j*.

The vibrator consists of an electro-magnet G, preferably of horse-shoe form, having an armature G′ mounted on or forming part of the lever F, and a circuit-breaker consisting of a contact spring *k* and contact screw *k′*, the spring *k* mounted on the armature lever so as to be drawn out of contact with the screw upon the attraction of the armature. A retracting spring H is provided for drawing the armature away from the magnet. To avoid too rapid vibrations and amplify the vibratory movements, the lever F is preferably provided at its outer end with a weight *w*.

The magnet G is arranged in circuit, as shown in Fig. 6, with a battery or other source of electric energy J, and in this circuit is introduced a circuit-closer which as a whole is lettered K, and by which the circuit is held normally open. In the construction shown this circuit closer consists of two vertically sliding metal pins L and M, connected to the opposite circuit wires and constituting respectively primary and secondary circuit terminals or contacts. The pin L is guided freely in holes formed in bent-up ears of a plate *l*, while the pin M is similarly guided in a like plate *m*, both pins being provided with stops consisting of attached plates *l′ m′* for limiting their downward movement.

Referring to Fig. 6, the circuit may be traced from the primary contact terminal L by wire 2 to battery J, by wire 3 to binding post 4, thence through the metal plate or frame designated by the line 5 to the pivot *j* of the armature G′, through the spring *k* and screw *k′*, thence by wire 6 through the coils of magnet G by wire 7 to binding post 8, and thence by wire 9 to the opposite or secondary contact terminal M.

To close the circuit the contact pin L is lifted until it touches the contact pin M, whereupon the current flows over the path just traced, exciting the magnet G, attracting the armature G′, and drawing the spring *k* away from the stop *k′* so as to break the circuit, whereupon the armature falls off from the magnet, the contact between *k* and *k′* is restored, the current again flows re-exciting the magnet, and so on, whereby the armature and armature-lever are set into vibration, which continues as long as the contact terminals L M are maintained in contact, and the electrical energy is supplied from the battery J.

I will now describe the means for automatically closing the circuit whenever it is required to rewind the clock, and for automatically breaking it to stop the rewinding operation when the spring or weight has been rewound to the required extent.

On the wheel *a* of the clock movement which revolves once each hour, or upon any other suitable revolving part of the movement, is formed or mounted a projection P, which serves the purpose of a cam. This projection is preferably constructed as a pin fixed to the wheel *a* as shown. Projecting into the path of this pin is one arm Q′ of a lever Q, fulcrumed at *q*, and the other arm Q^2 of which projects beneath a horizontal pin or arm *q′* projecting from the contact pin L.

The weight of the pin L, or of the piece *l′* fixed to it, holds it normally depressed in the position shown in Fig. 3, so that the lever-arm Q′ is elevated. As the wheel *a* turns in the direction of the arrow 1 in Fig. 3, its pin or cam projection P in the course of time strikes the arm Q′ and rocks the lever Q, the opposite arm of which acting through the pin *q′*, lifts the contact pin L, and thereby moves it against the contact pin M and closes the circuit. The following operation then ensues: The vibrator V being set into vibration, a rapid up and down movement is communicated to the pawl E, which at each downstroke engages with the teeth of the ratchet-wheel D and propels this wheel forward a distance of one or more teeth, the backward movement of the ratchet-wheel being prevented by the pawl D′. Consequently the ratchet-wheel D executes an intermittent forward rotation in direction of the arrow 10 in Fig. 4, and through the intermediate wheel C′, it drives the gear-wheel C and winding arbor A^2 in the direction of the arrow 11, being the same direction that is indicated by the arrow 1 in Fig. 9. The winding arbor in turning in this direction winds up the spring A′. As the spring barrel A has run down to the extent of only one revolution, it is necessary to rewind this spring only to the same extent, and consequently it is required to stop the operation of the vibrator as soon as the arbor A^2 has completed one revolution.

To stop the vibrator it is necessary to separate the contact pins or terminals L M. This might be done by lowering the pin L, but with the construction shown this would be difficult of accomplishment, because this pin is still lifted by the lever Q, which lever is still in engagement with the projection P. The proportions should be such that the projection P will continue to operate upon the lever Q and consequently maintain the contact pin L lifted for closing the circuit for an interval of time considerably greater than that ordinarily required to rewind the clock. For example, if ordinarily the clock will rewind in say fifteen seconds, it is desirable to have the projection P maintain the lifting of the pin L for some minutes, say for example five minutes, in order to provide against any possible contingency by means of which the action of the vibrator might be interrupted. Such contingency might result from the grouping of several clocks upon one circuit, or from utilizing as the source of electric energy a battery or other generator the current from which is employed for other purposes, as for example the ringing of house bells or annunciators, so that in case the energy of the battery were diverted to some other use before the winding of the clock was completed, the period of a circuit closure at L M should be long enough to amply exceed any such possible diversion of the current from the clock. Accordingly my invention provides that the pin or contact terminal L shall remain elevated for a considerable time in the position for holding the circuit closed, and that in order to break the circuit upon the completion of the required winding operation, the opposite pin or contact terminal M shall in its turn be lifted in order to break contact between it and the pin L. This breaking of the circuit might be otherwise effected, this means of effecting it not being absolutely essential to my invention although being the preferred means.

The means provided by my invention for effecting the breaking of the circuit upon the winding arbor A^2 having been turned forward for one revolution or other predetermined distance, is preferably as follows: Another pin or cam projection R is provided in connection with the clock movement, being so mounted as to derive motion from the winding arbor A^2. The preferred construction is to mount this pin R on a planet-wheel S pivoted on a stud on the wheel a or spring barrel A so as to be carried thereby around the arbor A^2. This planet-wheel is in mesh with a pinion S′ fixed on the arbor A^2, the pinion having one-half the number of teeth of the planet-wheel. It results from this construction that during a rewinding operation, the forward rotation of the arbor A^2 revolves the planet-wheel S one-half a revolution, carrying its pin R from the position shown in Fig. 7 in the direction of the arrow 12, to the position shown in Fig. 8. The rewinding is thus stopped as hereinafter described, and the continued forward movement of the wheel a carrying the axis of the planet-wheel S around in the direction of the arrow 1, causes the planet-wheel to roll around the pinion S′, and thereby to turn backward or in the direction of the arrow 13 in Fig. 8, so that the pin R is carried back from the position shown in full lines in Fig. 8 to that shown in dotted lines, by which time the parts have again reached the position shown in Fig. 3, ready for the next rewinding operation. The pin or projection R acts upon another lever T, which is pivoted at t, and the arm T′ of which has its end bent back into the path of the pin R, as shown in Figs. 3 and 2, while its opposite arm T^2 projects beneath a small pin t' projecting from the contact pin M, so that the tilting of the lever T will raise the contact pin M.

In the operation of rewinding, as the winding arbor A^2 revolves and the pin R moves in the direction indicated in Fig. 7, it encounters the bent end of the lever-arm T′, striking it at or near the end of the revolution of the arbor, and thereby tilting the lever T and lifting the pin M, which thereby instantly parts contact with the pin L and breaks the circuit, thus stopping the vibrator. Both pins L and M now stand lifted and normally will continue to be lifted for some minutes as the clock movement advances. The forward movement of the wheel a carries the pin P downward in a circular path, while the pin R moves downward in an epicycloidal path, and at a slower rate of speed. The proportions of the levers Q T are such that as they are depressed by the advance of these pins and consequently continue to lift the contact pins L and M, the pin M is lifted at least as fast as the pin L, and preferably faster, in order to guard against closing the circuit again, and the pin P slips past the end of the lever Q and thereby releases and drops the pin L before the pin R slips past the end of the lever T and thereby releases and drops the pin M.

The employment of the exact construction of circuit-closer K that I have shown and described is not absolutely essential to my invention, as others of the many well known constructions of circuit-closers may be substituted therefor to the same essential effect. The described construction is, however, deemed preferable by reason of its simplicity and cheapness of construction and reliability of operation, there being no springs to lose their temper or become bent or otherwise get out of order, and the pressure with which the two contacts come together being accurately determined by the weight imparted to the pin M, which in practice I counterweight by forming a ball on its end or otherwise. It will be understood that the plates l m are fastened to an insulating base or block n by which they are insulated from each other. Preferably in order to insure a positive electrical connection independent of any sliding contact, I connect the pins L and M with the respective metal plates by fine coiled wires r r, as shown, and I likewise connect the armature G′ or spring k to the metal plate or frame by a similar coiled wire r', as shown in Fig. 3.

By means of the mechanism provided by my invention for breaking the circuit upon the completion of the rewinding of the actuating spring to the required extent, the like degree of tension is imparted at each winding, and the regularity of running of the clock is thereby insured. This result is consequently independent of any variations in the force or rapidity of operation of the electric vibrator, which will work with more or less energy according to the strength and condition of the battery. It follows that the running down of the battery and the consequent slower action of the vibrator as the battery becomes weaker, is of no consequence, since in such case it merely takes a few seconds longer to wind the clock than it would if the battery were of the full strength.

It will be understood that I might apply the ratchet-wheel D directly on the arbor A^2, but I prefer to introduce one or more pairs of reducing gears to diminish the motion by increasing the time required for the winding. I thus gain the advantage of an easier winding, as with every additional wheel that may be interposed, the force for the winding of the spring or weight will be proportionately lessened, the rapid vibrations of the vibrator easily supplying the increased number of movements thus made necessary to renew the exhausted tension of the spring or weight.

In the construction shown the vibrator is placed above the clock movement proper, and the thrust of the pawl against the ratchet-wheel is effected on the retractile stroke of the armature by the tension of the spring H. The contrary arrangement by which the thrust should be imparted during the attractive stroke by the direct pull of the magnet, however, might be substituted to the same effect.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two movable contact terminals normally out of contact, a circuit-closing mechanism operated by the clock movement for closing said terminals together to start the winding, and a circuit-breaking mechanism comprising a wheel geared to the winding arbor of the clock movement and a connection from said wheel to one of said terminals for separating said terminals to break the circuit and stop the winding whereby the winding ceases upon the completion of a determined extent of winding movement.

2. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two movable contact terminals, normally out of contact, a circuit-closing mechanism operated by the clock movement for moving the primary terminal into contact with the secondary, and a distinct circuit-breaking mechanism operated from the winding arbor of the clock-movement for moving the secondary terminal out of contact with the primary.

3. In a self-winding clock having an electric winding mechanism, a circuit-closer for controlling the electric circuit, combined with a circuit-closing mechanism consisting of a projection carried by the clock movement and an arm connected to the circuit-closer and standing in the path of said projection to be displaced thereby at each revolution, and a circuit-breaking mechanism for breaking the circuit when the winding is completed, consisting of a wheel geared to the winding arbor and having a projection, and an arm connected to said circuit-closer standing in the path of said projection to be displaced thereby when it is turned a distance corresponding to the required rewinding.

4. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two movable contact terminals, normally out of contact, a circuit-closing mechanism operated by the clock movement for moving the primary terminal into contact with the secondary, consisting of a projection carried by a wheel of the clock movement and an arm connected with said terminal and standing in the path of said projection to be displaced thereby at each revolution, and a circuit-breaking mechanism operated by the clock movement for moving the secondary terminal out of contact with the primary when the winding is completed, consisting of a wheel geared to the winding arbor and having a projection, and an arm connected to said secondary terminal and standing in the path of said projection to be displaced thereby when it has turned a distance corresponding to the required rewinding.

5. In a self-winding clock having an electric winding mechanism, a circuit-closer for controlling the electric circuit, combined with a circuit-closing mechanism consisting of a projection P carried by the clock movement, and an arm Q′ connected to the circuit-closer and standing in the path of said projection to be displaced thereby at each revolution, and a circuit-breaking mechanism for breaking the circuit when the winding is completed consisting of a planet-wheel carried by one of the wheels of the clock movement and meshing with a pinion connected to the winding arbor, a projection R from said planet-wheel, and a movable arm T′ connected to the circuit-closer and standing in the path traversed by said projection R when moved by the advance of the winding arbor so as to be displaced thereby to operate the circuit-closer to break the circuit.

6. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two vertically-sliding pins one above the other, normally out of contact, and a mechanism in connection with the clock movement for lifting the lower pin into contact with and to lift the upper pin.

7. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two vertically sliding pins, normally out of contact, a circuit-closing mechanism operated by the clock-movement for lifting the lower pin into contact with the upper one to close the circuit, and a circuit-

breaking mechanism operated by the clock-movement for lifting the upper pin out of contact with the lower one to again break the circuit.

8. In a self-winding clock having an electric winding mechanism, a circuit-closer consisting of two movable contact terminals normally out of contact, a circuit-closing mechanism operated by the clock movement for lifting the primary terminal into contact with the secondary, and a circuit-breaking mechanism operated from the winding arbor of the clock movement for lifting the secondary terminal out of contact with the primary, the said circuit-breaking mechanism proportioned relatively to the advance of the clock movement to impart a subsequent lifting movement to the secondary terminal due to the advance of the clock movement in excess of the subsequent lifting movement imparted by the circuit-closing mechanism to the primary terminal, and the circuit-closing mechanism constructed to release and restore the primary terminal in advance of the release by the circuit-breaking mechanism of the secondary terminal, whereby after the breaking of the circuit the terminals are held out of contact until restored to their normal positions.

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

EMIL G. HAMMER.

Witnesses:
ARTHUR C. FRASER,
GEORGE H. FRASER.