(No Model.) 3 Sheets—Sheet 1.

F. L. GREGORY.

ELECTRIC CLOCK.

No. 537,032. Patented Apr. 9, 1895.

Fig. 3.

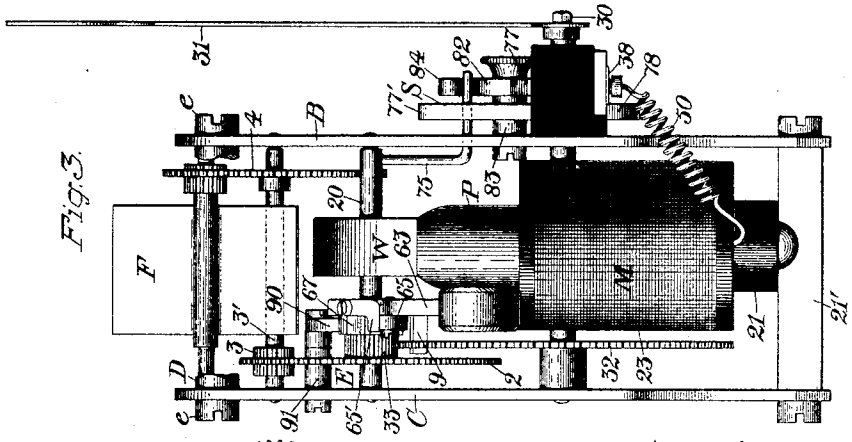


Fig. 2.

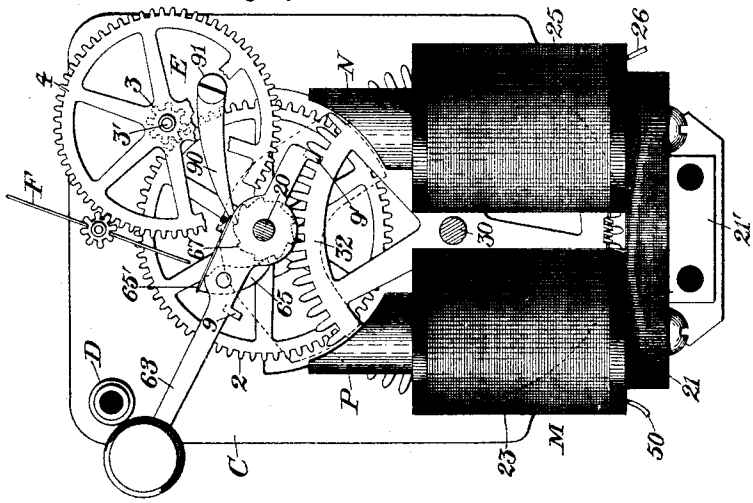
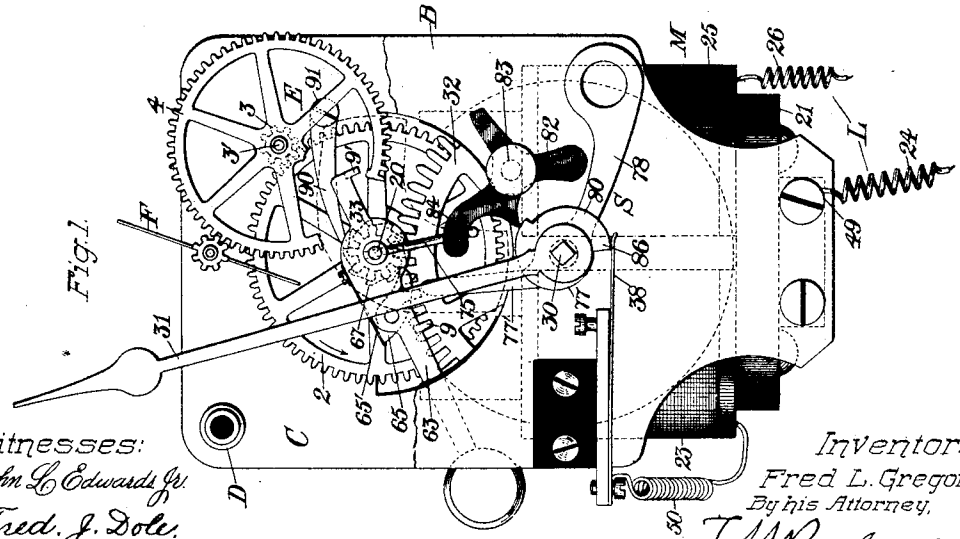


Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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ELECTRIC CLOCK.

No. 537,032. Patented Apr. 9, 1895.

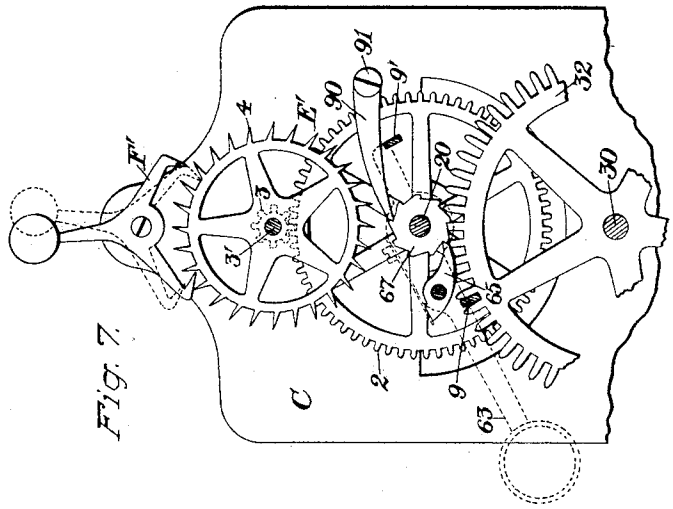

Fig. 7.

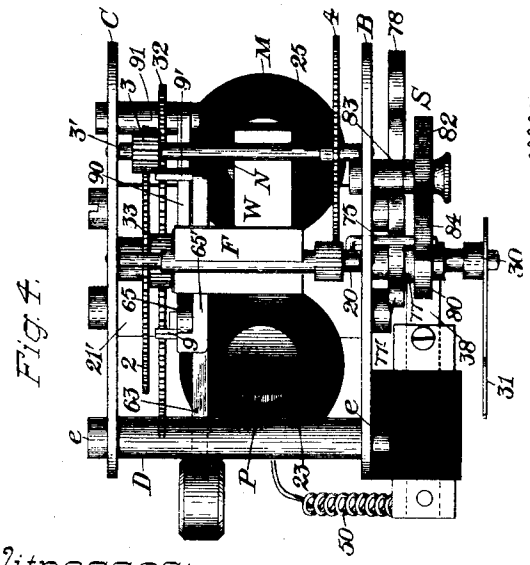

Fig. 4.

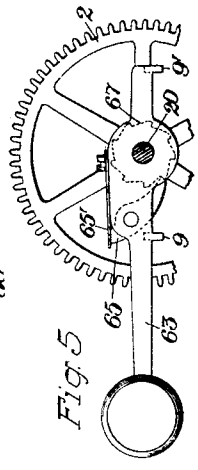

Fig. 5.

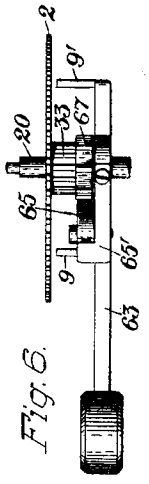

Fig. 6.

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(No Model.) 3 Sheets—Sheet 3.

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ELECTRIC CLOCK.

No. 537,032. Patented Apr. 9, 1895.

Fig. 9.

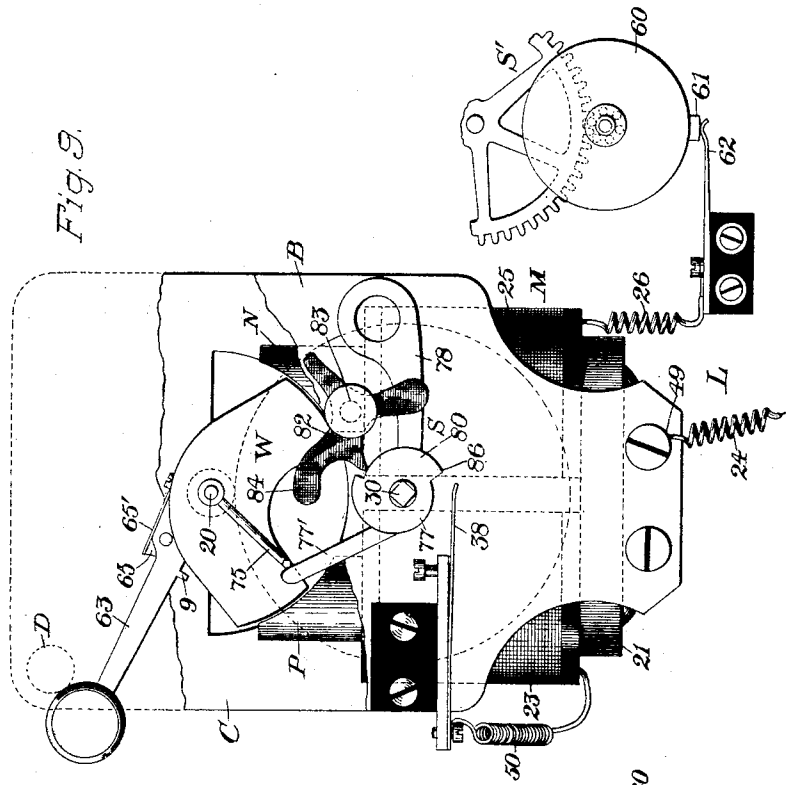
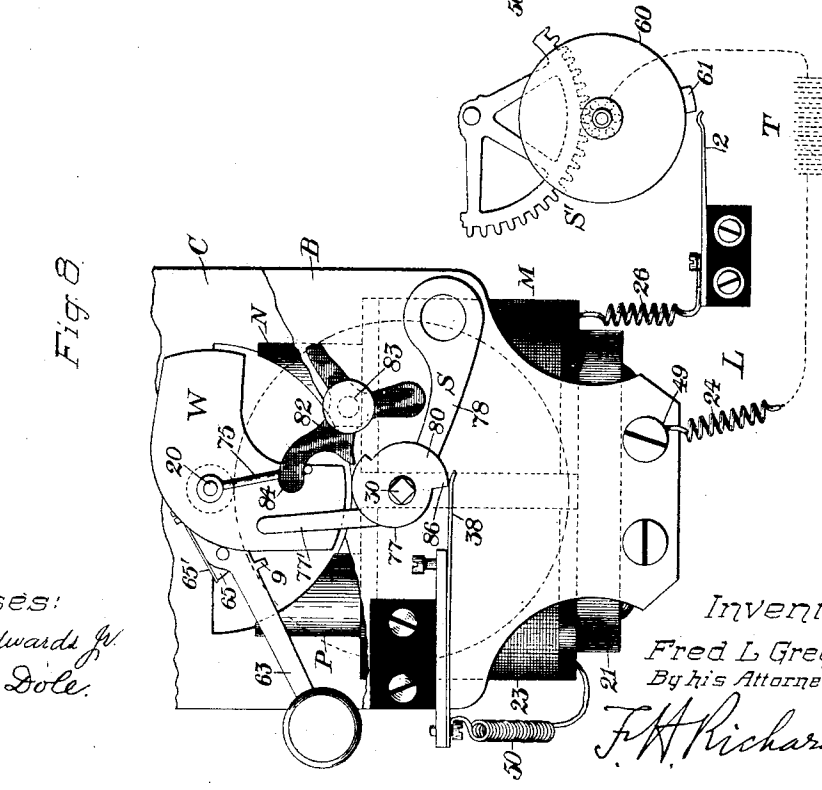


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRED L. GREGORY, OF CHICAGO, ILLINOIS.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 537,032, dated April 9, 1895.

Application filed January 30, 1894. Serial No. 498,522. (No model.)

To all whom it may concern:

Be it known that I, FRED L. GREGORY, 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 Electromechanical Clocks, of which the following is a specification.

This invention relates to electro-mechanical clocks of the class in which the clock-train mechanism is propelled through the medium of actuating mechanism intermittently operated by electro-magnetism, and is in the nature of an improvement upon the clock-mechanism shown and described in Letters Patent of the United States No. 455,532, granted to me July 7, 1891, to which reference may be had.

The object of my invention is, primarily, to provide an electro-mechanical clock complete in itself and capable of operation independently of a master time-piece, and to so construct and organize the same that it may constitute a "secondary" clock-mechanism capable of being operated and regulated by the operation of a master time-piece which will cause electric impulses to be transmitted to the secondary clock at predetermined intervals.

Another and important object of the invention is to provide a clock-mechanism so organized as to reduce to a minimum the expenditure of electrical energy requisite for its practical operation, and also to provide means for imparting a gradual movement at predetermined intervals to, and for regulating the movement of, the clock-hand, thereby obviating sudden movements thereof from one resting place to another.

In the drawings accompanying and forming a part of this specification, Figure 1 is a front elevation of an electro-mechanical clock-mechanism embodying my present improvements, and adapted for use in connection with, and for actuating a clock-train of any suitable construction, a portion of the front plate of the frame being broken away to show the parts more clearly. Fig. 2 is a view similar to Fig. 1, of the clock-mechanism with the front-plate and portions of the mechanism removed, the parts being shown in a different position from that illustrated in Fig. 1. Fig. 3 is a side elevation of the same looking from the left-hand in Fig. 1. Fig. 4 is a plan view of the same. Figs. 5 and 6 are side and plan views, respectively, of a portion of the clock-mechanism showing the reciprocating lever and its connection with the rock-shaft and the pinion which actuates the clock-hand shaft. Fig. 7 is a front elevation of one form of device for regulating the movement of the clock-train. Fig. 8 is a view similar to a portion of Fig. 1, for illustrating the operation of the mechanism, and the connection thereof with the master time-piece. Fig. 9 is a view similar to Fig. 8, for illustrating a later step in the operation of the apparatus.

Similar characters designate like parts in all the figures.

Briefly stated, this clock as a whole, contains, essentially, a time-train, an electrically-propelled time-train actuator, an electrical-circuit embodying a magneto electrical coil or magnet, a main circuit-maker-and-breaker for intermittently energizing said coil or magnet to propel the time-train actuator and a supplemental locking-switch or circuit-breaker, to reduce the expenditure of electrical energy by breaking the circuit intermediate to the clock-train actuator and main circuit-breaker.

The operative parts of the mechanism are shown in the drawings as carried by the framework having the usual front-plate B and back-plate C, these plates being connected together by pillars, D, and screws, *e*, after the usual manner of constructing clock-frames.

The time-train of the clock, which may be of any usual or suitable construction and organization, is not entirely shown herein as it is not deemed necessary to an understanding of my present improvements, but in the drawings, Figs. 1, 2, 3 and 4, I have shown the usual staff or pointer-shaft, 30, of a time-piece journaled in the plates B and C of the frame and carrying on its front end, the pointer or minute-hand, 31, of the clock, and at its rear end, the gear-wheel 32, which meshes with and is driven from a pinion, 33, herein shown as loosely mounted upon the rear end of the power-shaft 20.

The clock-train actuating mechanism, as shown in the drawings, comprises, essentially, a power-shaft 20, actuated by an electrical motor apparatus embodying an armature, or weight, W, secured to said power-shaft, an electro-magnet, M, and an electric circuit.

This armature W is arranged to oscillate adjacent to the poles P and N of the electro-magnet M, which magnet is supported in the framework of the mechanism by its connecting-bar, 21, screwed to and transversely of the plate or bar, 21′, of the framework. Loosely mounted upon the rear end of the power-shaft 20, as shown, or if desired, upon some shaft (not shown) immediately adjacent thereto, is a driving pinion, 33, which, as before stated, meshes with the gear-wheel 32 of the hand-shaft. Secured to or formed upon the front side of said pinion 33 is a ratchet-wheel, 67, the teeth of which are engaged by a pawl, 65, of a power-lever 63, secured to the power-shaft 20. By means of this pawl and lever, said ratchet-wheel is rotated during the downward or return movement of said lever to intermittently actuate the clock-train which includes the pointer-shaft and pointer secured thereto.

As a means for imparting a gradual movement to the clock-train and its hands or pointers, (one only of which is shown in the drawings,) and for regulating said movement, the pinion 33 is provided with a gear-wheel, 2, which may mesh with a pinion, 3, of a fan-train mechanism as shown in Figs. 1, 2, 3, and 4, or with an escapement-wheel as shown in Fig. 7, which fan-train, or escapement-train, is designated in a general way by E and E′, respectively, and has in connection therewith, either a rotary fan, F, as shown in Fig. 1, or an escapement-anchor, F′, as shown in Fig. 7, which serves to control the movement of its respective fan-train or escapement-train, and in consequence regulates the movement of the clock-train. This regulating mechanism E or E′, in the preferred form thereof herein shown consists, essentially, of the gear-wheel 2 formed upon or secured to pinion 33, a pinion, 3, in mesh with said gear-wheel, which pinion is secured to the shaft, 3′, journaled in the frame, a gear-wheel 4 as shown in Fig. 1 (or an escapement-wheel, as shown in Fig. 7) carried by said shaft 3′, and a fan-wheel (or an escapement-anchor) in connection with said gear-wheel 4, (or escapement-wheel) to control the movement thereof.

The power-shaft 20 is directly actuated by the oscillation or the vibratory movement of the armature W, which armature is propelled by the magnet M energized periodically by an electric current through a circuit, as L, having some suitable circuit maker and breaker which is operated, when the mechanism described is used as a secondary clock, by the time-train of the "master" time-piece. This energization of the magnet M and consequent movement of the armature W may take place at intervals of more or less length as may be desired, the mechanism shown in the drawings being organized for actuation at intervals of one-minute length.

When the clock herein described is used independently of a master time-piece and the main circuit L, the magnet M may be energized in the manner described in my aforesaid patent, from a small battery of requisite strength such as the so-called "dry battery" now very generally employed which will be in direct electric connection with the magnet M and time-train-actuator, the circuit-breaker or switch S, in this instance, acting to automatically and intermittently close the electric circuit for effecting its own operation and the operation of the time-train.

The winding of the magnet coils and the connection of the same with the source of electric supply, (be it either a primary battery supplying electrical energy to a series of secondary clocks in a circuit of which this clock forms a unit, or a battery in direct connection with the magnet coils) should, of course, be done in such a manner as to actuate the magnet armature W in the direction required by the character of the operative parts hereinafter more fully described.

The armature, which is herein shown as carried by the power-shaft 20 suitably journaled in the frame-plates B and C, is, on its outer side, substantially concentric with its supporting shaft and is held in position to oscillate in close proximity to the poles P and N of the magnet as will be understood from the drawings and my aforesaid Letters Patent. When the armature is swung forward (toward the left-hand) to the position shown by dotted lines in Fig. 2, the pawl 65 passes over one of the teeth of the ratchet-wheel 67, and on the descent of the said armature, together with the power-lever 63, turns said wheel, and through it drives the fan-train (or escapement-train) which in turn limits the velocity of the return-stroke of the power-lever and armature and consequently regulates the movement of the time-train in operative connection therewith. The power-lever also constitutes a stop-arm for carrying alternately-acting stop-pins, 9 and 9′, the one 9 of which is constructed and arranged for engaging, on the downward movement of said stop-arm, in the space between two adjacent teeth of the minute-wheel 32, and the one 9′ is constructed and arranged for engaging, on the upward stroke of said stop-arm, between two adjacent teeth of said wheel. Thus it will be seen that the minute-wheel and connected time-train will be held against movement at the extreme ends of both the upward and downward movements of the power-lever or stop-arm.

By providing stops upon the power-lever 63 one at each side the axis thereof for engagement with the minute-wheel at each end of the throw of said lever, it will be seen that the time-train is positively locked against forward or backward movement at both ends of the stroke of the power-lever, and, in consequence of the extreme rapidity of the retractive movement of the power-lever caused by the instantaneous electric propulsion thereof, said time-train is practically locked against movement at all times with the exception of that time coinciding with the effective advancing movement of the power-lever or actu-

ator, or during its movement from its extreme upper to its extreme lower position. This is a matter of considerable importance in that it prevents accidental movement of the time-train from extraneous causes.

The electrical circuit for energizing the magnet will usually consist of the two terminals 24 and 26, one of which 26 is shown leading directly to the coil 25, while the other 24 is connected at 49 to the metallic frame. Connection is made with the other coil 23 through the wire 50, which leads to the contact-point, or spring 38.

When this clock constitutes one of a series of clocks in a circuit, and is to be actuated by a master time-piece, the magnet M will be energized through the main conductors L supplied by a primary battery (shown by dotted lines at T in Fig. 8) which energizes the magnets of all the clocks in the same circuit. In this case a circuit maker and breaker, (designated in a general way by S′,) is employed in the circuit L intermediate to the magnet M and the primary clock mechanism which operates it, as will be clearly understood by reference to Figs. 8 and 9 of the drawings, which show a portion of said clock mechanism. This circuit maker and breaker may, as shown in said Figs. 8 and 9, consist of a wheel, 60, in electrical connection with the main battery T, and have a projection, 61, thereon adapted for intermittently engaging a contact-arm, 62, in the electrical circuit L, said circuit maker being operated and timed in its movements by the time-train, (a portion only of which is shown) of the primary or master time-piece to make and break the circuit at predetermined intervals. This rotary circuit maker may be constructed and arranged in connection with the time-train of the master time-piece, to make one complete revolution a minute, thereby completing the circuit L by the contact of the projection 61 with the contact point 62 of the circuit. The construction and arrangement of the primary circuit maker may be varied as circumstances may require.

As a means for making and breaking the circuit intermediate to the magnet M and the time-train actuator, and as a means for rendering the clock-mechanism operable independent of a master time-piece, I have provided an independent circuit-breaker, or switch, designated in a general way by S, in direct connection with the frame of the clock mechanism, (which switch is also referred to herein as the "secondary" circuit-breaker.) This circuit-breaker, or switch is herein shown as consisting of a main body-portion or hub, 77, having a detent-rim, 80, and having a contact-point, 86, for making the electrical circuit through the terminal 38, which hub 77 is herein shown as pivotally supported upon the pointer-shaft 30, it being obvious, however, that it might be supported on an independent stud secured to the frame. Said switch has means, as, for instance, the weighted lever 78, fixed thereto, for moving it to close the circuit, (as shown, for instance, in Figs. 1 and 8) when said switch is released from its locking device. As a means for actuating the switch to break the circuit by throwing its contact point 86 out of engagement with the terminal 38, the said switch is provided with an upwardly extended arm, 77′, for operating the same on the retractive movement of the power-lever and its shaft. This arm 77′ is actuated by means, preferably, of a switch-actuating arm, 75, secured to the power-shaft 20 (or the power-lever 63) constructed and arranged for engagement with the switch-arm 77′ upon the retractive movement of said power-shaft and lever, partially rotating the switch upon its pivot and throwing it out of engagement with the terminal 38, thus breaking the circuit.

As a means for locking the switch in its retracted or open position, and to retain the same in such position until the clock-train has been moved the requisite distance by the descent of its actuator, I have provided a detent-pawl, or switch-lock, 82, preferably pivoted upon a stud, 83, fixed in the frame which is adapted for engagement with the detent-rim of, and locking the switch during the descent of the power-lever. This switch-lock has an arm, 84, which projects into the plane of movement of the switch-actuating arm 75 of the power-shaft (or power-lever) and is adapted to be engaged by said arm 75 near the termination of the downward stroke of the power-lever, whereby the switch-lock is thrown out of engagement with the switch, at which time the switch, through the medium of the weighted lever 78, will be thrown quickly into contact with the terminal 38 and complete the circuit. This switch or circuit-breaker S and its locking-device are important factors in the operation of the clock-mechanism, and materially assist in reducing the expenditure of electrical energy necessary to secure the best practical results, as will be hereinafter more fully explained. The switch, switch-locking and actuating device constitute a circuit maker and breaker operable entirely independent of a master time-piece and are adapted for controlling the actuation of the time-mechanism of the clock to which it is attached, when said clock is provided with an independent battery, and is run as an independent time-piece. This is of material importance for the following reasons: When a number of secondary clocks are driven or controlled by the movements of a master time-piece, and depend entirely for electrical energy upon a main or primary electrical conductor, they are liable to be stopped or to be thrown out of synchronism by any accident to the primary clock, or to the main conductor of the system. Therefore it is desirable to provide for the operation of each individual clock of the system independent of the master time-piece and the main electric conductor of the entire system, and to do this with my improved clock-mechanism, should accident occur to

the main conductor of the system of which this clock forms a unit, it is simply necessary to connect the wires of the terminals 24 and 26 to the independent battery of the clock affected by the accident to the main circuit, which renders this clock independently operable. The circuit breaker (or switch S, in this case) then acts to complete the circuit for actuating and controlling the movements of the clock-train of the clock to which it is connected, thus obviating the inactivity or stopping of the same during the repairing of the master time-piece or main conductor. Another function of the circuit breaker or switch S and its locking device is to increase the life of the battery upon which the clock depends for electrical energy by decreasing the expenditure and waste of electrical energy to the minimum. This is accomplished by the instantaneous breaking of the circuit through the medium of the switch S coincidently with the first electrical impulse imparted by the making of the main circuit through the medium of the master time-train, (which first impulse starts the power-lever in its upward movement with sufficient force to insure its complete stroke,) and the retention of the circuit in an open condition through the medium of the switch-lock until the power-lever has completed its downward movement, the clock-train has carried the hands the requisite distance, and the magnet M is again energized by the making of the circuit in the main line which will repeat the operation. This waste of energy, it will be readily understood, would be considerable if but one circuit-maker-and-breaker were employed to control the movements of all of the clocks in the circuit, as, for instance, waste might be occasioned by the momentary stopping of the master time-piece which actuates the circuit maker just as the circuit maker completes the circuit which would retain the magnets of all the clocks in the series in an energized condition until this contact was broken by the continued movement of the time-train.

A detent-pawl, 90, will, in practice, be employed for preventing the backward movement of the time-train on the retraction of the power-lever 63, which might be caused by either the friction of the power-shaft within the pinion 33 or by the weight of an unbalanced minute-hand or from other extraneous causes. This pawl 90 will be pivotally supported upon a stud, 91, secured to the frame, and its opposite end will engage the ratchet-wheel 67 at the side opposite that engaged by the pawl 65 upon the power-lever.

By reason of the organization and combination of mechanism herein described, the power-lever 63, being connected with the fan-train or escapement-train through the ratchet and pawl as hereinbefore described, has a free retractive movement, which does not influence or affect the time-train, but on the downward or forward movement of the power-lever, the pawl carried thereby engages the ratchet-wheel to actuate the time-train and also for operating the fan or escapement-train as hereinbefore described.

When this clock constitutes one of the series of clocks in a circuit, all of which are governed by the operation of a master time-piece, the time-train thereof will, in practice, have a slight "lead" over the time-train of the master time-piece, or, in other words—the mechanism of the clock will be so regulated in its movements as to carry the pointer or minute-hand the distance of a minute-arc, in—say two-thirds or three-quarters of a minute of time, at the end of which two-thirds or three-quarters of its minute, it remains dead until again actuated by an electrical impulse imparted to it through the movements of the master time-piece.

In the drawings I have shown the minute-wheel of the time-train as adapted for being revolved a distance requisite to carry the pointer the length of a one-minute arc of a circle divided into sixty one-minute arcs at each complete movement of the power-lever 63.

The general operation of the mechanism herein described is as follows: Assuming that suitable connection has been made with a battery by means of the wires 24 and 26, and that the parts of the mechanism are in the position shown in Figs. 1, 3 and 8, the circuit will then be made through the medium of the master time-piece and primary circuit-maker S′, and the magnet M of the time-piece will be energized through the main line L which will instantaneously propel the armature carrying it together with the power-lever 63, from the position shown in Fig. 8, to the position shown in Fig. 9. During the upward movement of the power-lever, the switch-actuating arm 75 herein shown as secured to the power shaft, strikes the arm 77′ of the switch, throwing said switch out of contact with the terminal 38, the switch-lock then dropping into engagement with the switch and holding the same in an open position until the power-lever has nearly completed its downward movement. A stop, which in this instance is one of the pillars D, is provided to limit the retractive movement of the power-lever 63. During this movement the time-train is not affected by the action of the lever, the pawl 90 in engagement with the ratchet-wheel 67 preventing movement thereof as before described. On the return or downward movement of the power-lever, the pawl 65 thereof engages the teeth of the ratchet-wheel 67, (said pawl being held in engagement with said ratchet-wheel by means of the spring 65′ bearing against one end of the pawl as shown in the drawings) which carries said ratchet-wheel and operates the fan-train or escapement-train, and through it drives the time-train. As the power-lever approaches the end of its downward stroke, the switch-actuating arm 75 strikes the arm 84 of the switch-lock, throwing the switch-lock out of engagement

with and permitting the switch to immediately drop into contact with the terminal 38 which will complete the circuit at this end of the line L with the parts of the mechanism in position to be affected by the re-energization of the magnet through the next electrical impulse occasioned by the making of the circuit at the master time-piece end of the main line L.

The operation of the mechanism of the clock will be practically the same when the clock is operated independently of the "master time-piece" with the exception that the time-train will be regulated so as to carry the hand the length of a one-minute arc in one-minute's time.

Certain of the features and combinations herein described and claimed are also shown and described, but are not claimed, in a prior application, Serial No. 472,052, filed April 27, 1893, to which reference may be had; said subject-matter, which is therein reserved, being shown in said prior application in connection with other subject-matter not directly related to the principal features of my present invention.

Having thus described my invention, I claim—

1. In an electro-mechanical clock, the combination with the time-train thereof, of an electrically-propelled reciprocatory actuator in operative connection with and adapted for intermittently actuating the time-train, a resistance speed-regulator, substantially as described, in connection with the time-train and adapted for regulating the movement of said time-train and for regulating the effective velocity of the actuator, and means in position and adapted for locking the time-train against forward or backward movement at each end of the stroke of the actuator, substantially as described and for the purpose set forth.

2. In an electro-mechanical clock, the combination with the time-train thereof, of a power-shaft, an electrically-propelled power shaft-actuator, means in operative connection with the power-shaft-actuator and time-train in position and adapted for locking the time-train against forward or backward movement at each end of the stroke of the actuator, a switch in circuit with the power-shaft, means for intermittently actuating said switch, and a resistance speed-regulator in operative connection with the time-train and adapted for regulating the movement of said time-train and the effective working stroke of the actuator, substantially as described.

3. In an electro-mechanical clock, the combination with the time-train thereof and with the electrically-propelled time-train-actuator, of a time-train-stopping device carried by the actuator and adapted for engaging and stopping the time-train at each end of the stroke of the actuator and for positively locking said time-train against forward or backward movement, substantially as described.

4. In an electro-mechanical clock, the combination with the time-train, of a power-shaft, an electrically-propelled reciprocatory power-shaft-actuator, a locking-switch in circuit with the power-shaft-actuator, a resistance speed-regulator in connection with the time-train and power-shaft-actuator, and a time-train-stopping device carried by the actuator in position and adapted for engaging and stopping the time-train at opposite ends of the stroke of the actuator and for positively locking said time-train against forward or backward movement, substantially as described and for the purpose set forth.

5. In an electro-mechanical clock, the combination with a power-shaft connected with and adapted for actuating the time-train of the clock, of an electrically-propelled power-shaft-actuator, a resistance speed-regulator in operative connection with the power-shaft-actuator, a locking-switch in circuit with the power-shaft-actuator, a switch-locking actuator located between the power-shaft and switch, and alternately-acting means carried by the power-shaft-actuator in position and adapted for intermittently locking the power-shaft-actuator and connected mechanism against movement, substantially as described.

6. In an electro-mechanical clock, the combination with the time-train thereof and with a power-shaft for actuating said time-train, of a reciprocatory power-shaft-actuator, electro-mechanical means for periodically propelling said actuator, a speed-regulator in operative connection with the time-train and power-shaft-actuator, an electrical-terminal, a switch intermediate to said terminal and the shaft-actuator, means for periodically actuating said switch, and alternately-acting locking-means carried by the actuator in position and adapted for intermittently engaging and locking the time-train, substantially as described and for the purpose set forth.

7. In an electro-mechanical clock, in combination, a time-train, an electrical motor in operative connection with and adapted for periodically imparting movement to the time-train, an electro-magnet, means for energizing said magnet, an electrical-terminal, means substantially as described intermediate to said terminal and motor and adapted for periodically opening and closing the electrical circuit, and alternately-acting locking-means in position and adapted for intermittently locking the time-train and motor at given points in the movement of said motor, substantially as described and for the purpose set forth.

8. In an electro-mechanical clock, the combination with a power-shaft adapted for connection with a clock-mechanism, of a reciprocatory electro-magnetic motor operatively connected with said power-shaft, a power-shaft-regulator in operative connection therewith, an electro-magnet, an electrical-circuit for energizing said magnet, an electrical terminal intermediate to said magnet and motor, an oscillatory switch supported intermediate

to said terminal and power-shaft, a switch-actuator in connection with said power-shaft and adapted for periodically actuating said switch to open and close the circuit, and alternately-acting locking-means connected with, and controlled in its movements by, the motor and adapted for engagement with, and for locking a clock-train and the motor against forward or backward movement at certain periods in the movement of the motor, substantially as described and for the purpose set forth.

9. In an electro-mechanical clock, the combination with the power-shaft and with the time-train with which said power-shaft is operatively connected, of a reciprocatory power-shaft-actuator, an electrical circuit including an electro-magnet, a circuit-closer for periodically making and breaking said circuit through said power-shaft and actuator, means substantially as described for periodically energizing and de-energizing the electro-magnet to intermittently propel the power-shaft, and locking-means in position and adapted for arresting the movements of the power-shaft, its actuator and the time-train at opposite ends of the throw of the actuator and for positively locking said parts against forward or backward movement, substantially as described.

10. An electro-mechanical clock-mechanism comprising a clock-train, a power-shaft in operative connection with said clock-train, a reciprocatory power-shaft-actuator, an electro-magnet, an electrical supply-circuit for energizing the magnet, a circuit-breaking switch intermediate to the magnet and the power-shaft-actuator, a power-shaft regulator in operative connection with said power-shaft, means substantially as described for deenergizing the magnet during the major part of the movement of the power-shaft and its actuator, and alternately-acting means substantially as described for intermittently locking the time-train against movement, substantially as and for the purpose set forth.

11. In an electro-mechanical clock, the combination with the time-train and with a power-shaft in connection with said time-train, of a reciprocatory power-shaft-actuator electrically propelled in one direction, means for imparting a return movement to said actuator, alternately-acting means in connection with and adapted for locking the actuator and time-train against movement for a short period at each end of the stroke of the actuator, means for closing an electric circuit for propelling the shaft-actuator, and means substantially as described for interrupting the circuit upon the beginning of movement of said actuator and for maintaining an open circuit until the actuator approaches its normal or inactive position, as set forth.

12. In an electro-mechanical clock, the combination with the time-train thereof, of a stop-wheel, an electrically propelled stop-wheel-actuator, means substantially as described embodying an electro-magnet and an electrical circuit, for periodically propelling the stop-wheel-actuator to impart a movement to the stop-wheel, and alternately-acting locking-means carried by said actuator in position and adapted for periodically engaging and locking the stop-wheel against movement, substantially as described.

13. In a synchronizing clock system, a source of electrical energy, a circuit of conductors leading therefrom, a plurality of electro-magnets in said circuit, an automatic primary circuit-controller intermediate of said source of energy and the electro-magnets, a power-shaft or time-train-actuator for each of said electro-magnets and adapted to be propelled by its electro-magnet and in circuit with the coils thereof, a secondary circuit-controller intermediate of said electro-magnet and its power-shaft-actuator, means in connection with said power-shaft-actuator and adapted for actuating its secondary circuit-controller for periodically closing the circuit to propel said actuator, and means substantially as described for intermittently and temporarily arresting the movement of the actuator and for positively locking said actuator against movement, as and for the purpose set forth.

14. In a synchronizing clock-system, an electro-magnetic clock embodying a time-train, a resistance speed-regulator in connection with said time-train, an electro-magnet, a secondary electrical circuit, a reciprocatory time-train-actuator, a secondary circuit-controller in circuit with the actuator, and a terminal of the secondary circuit and adapted for electrically propelling the actuator upon the energization of the magnet, in combination with a primary circuit embodying a primary circuit-controller in position and adapted for periodically opening and closing the primary circuit to periodically energize and deenergize the magnets of the clock-mechanism, and means for automatically actuating said primary circuit controlier, substantially as described and for the purpose set forth.

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