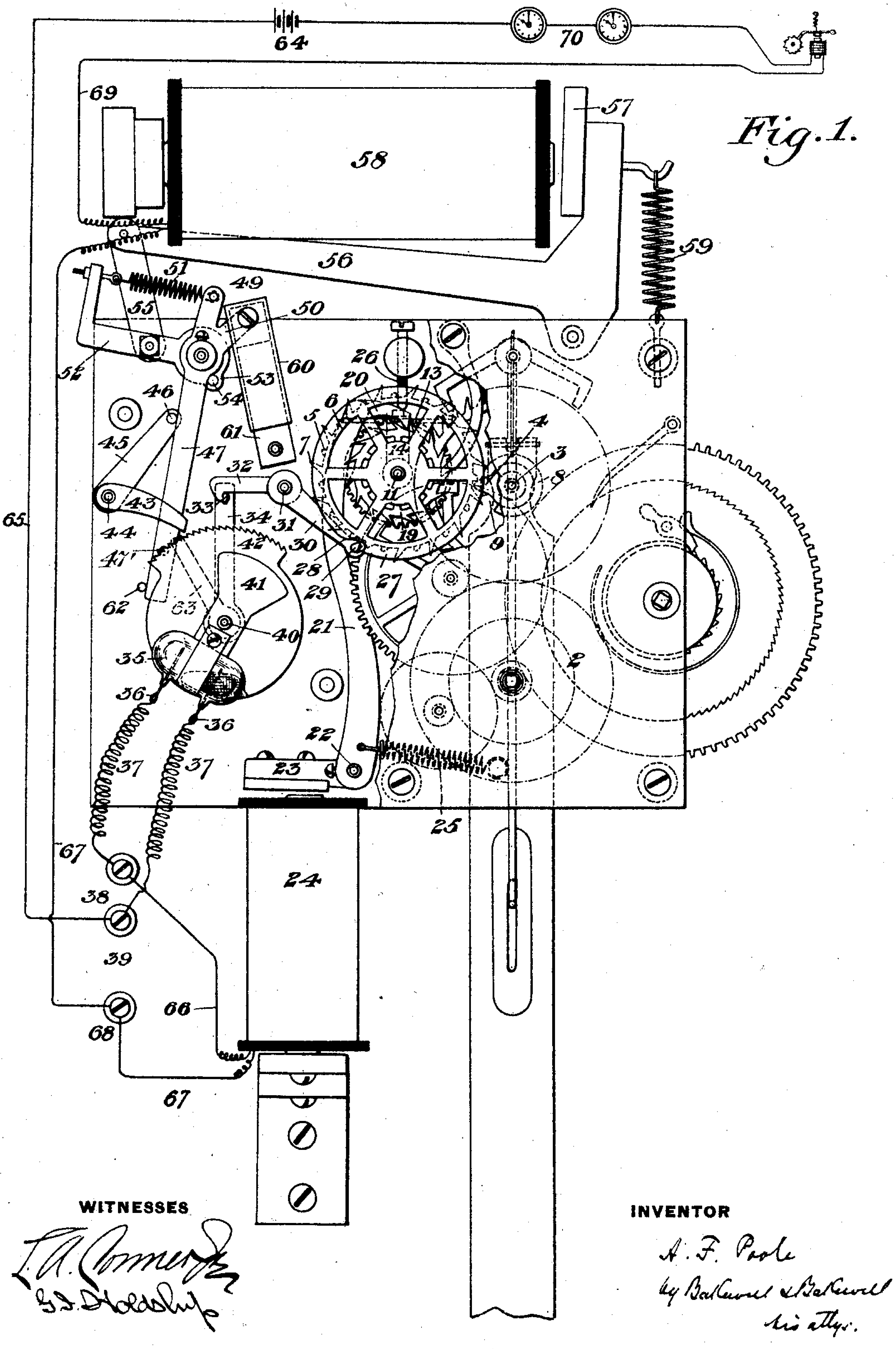
No. 631,511. Patented Aug. 22, 1899.

A. F. POOLE.

ELECTRIC CLOCK.

(Application filed June 23, 1898.)

(No Model.) 4 Sheets—Sheet 1.



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No. 631,511. Patented Aug. 22, 1899.

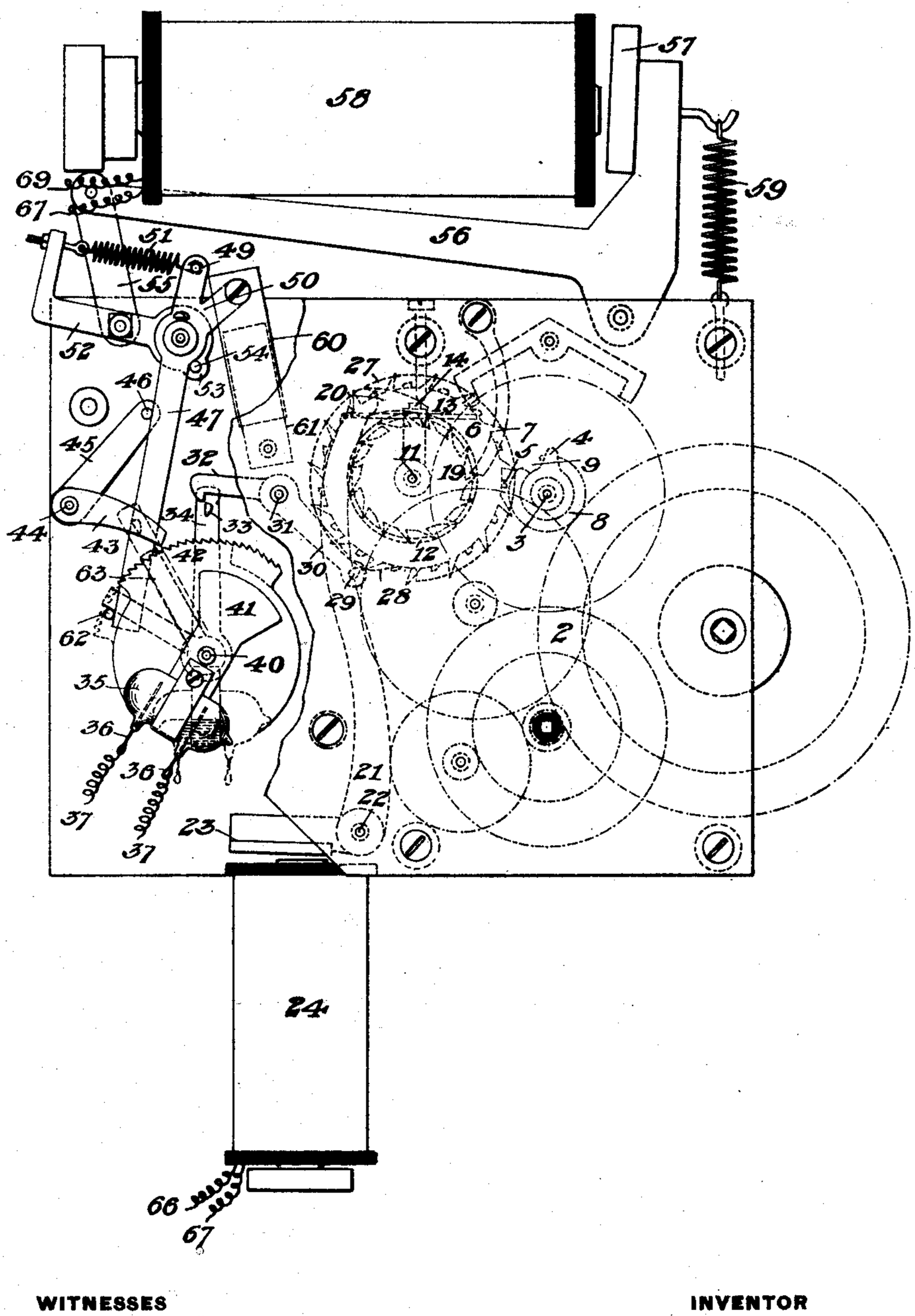
A. F. POOLE.

ELECTRIC CLOCK.

(Application filed June 28, 1898.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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No. 631,511. Patented Aug. 22, 1899.

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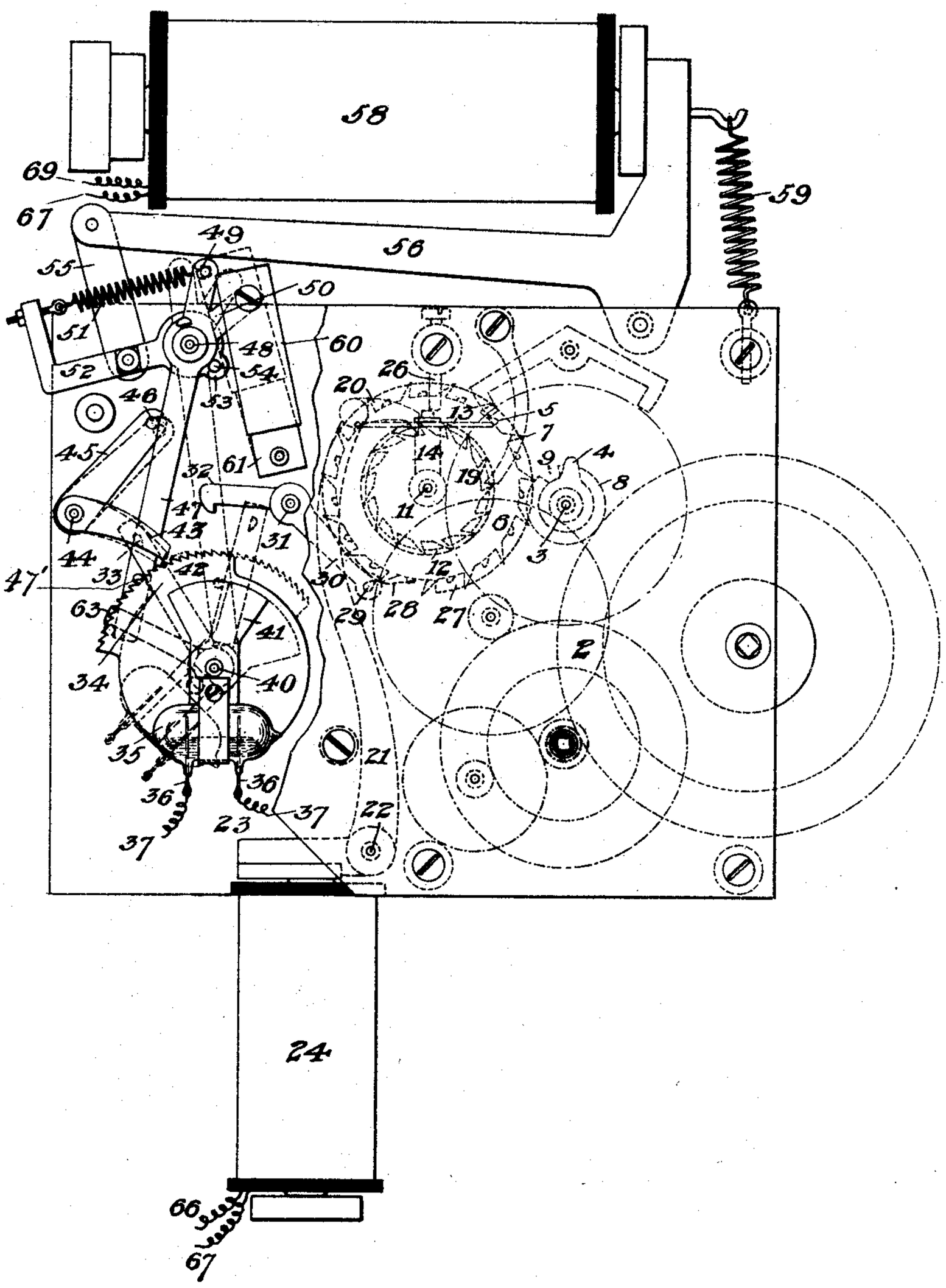
ELECTRIC CLOCK.

(Application filed June 23, 1898.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 3.



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No. 631,511. Patented Aug. 22, 1899.

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ELECTRIC CLOCK.

(Application filed June 23, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 4

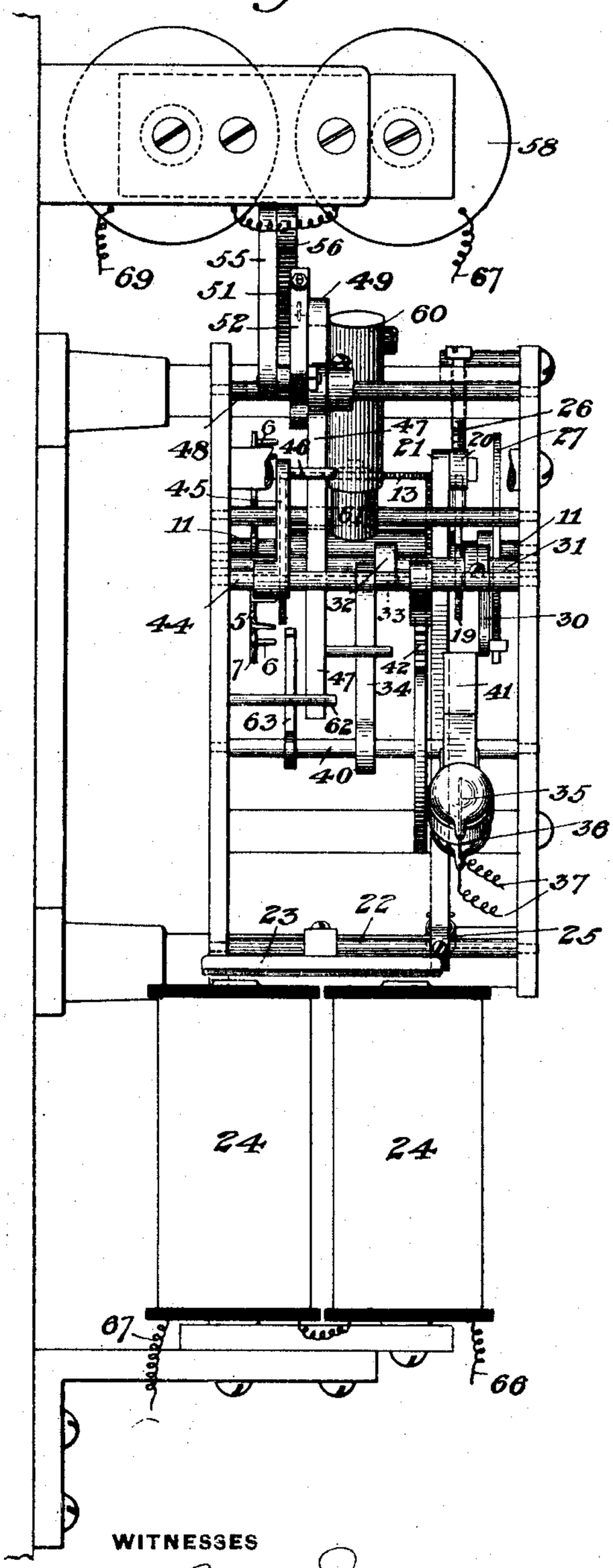


Fig. 5.

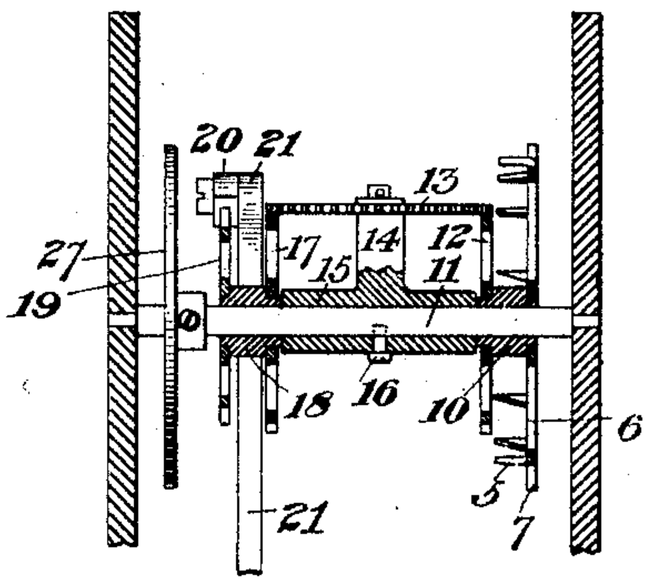
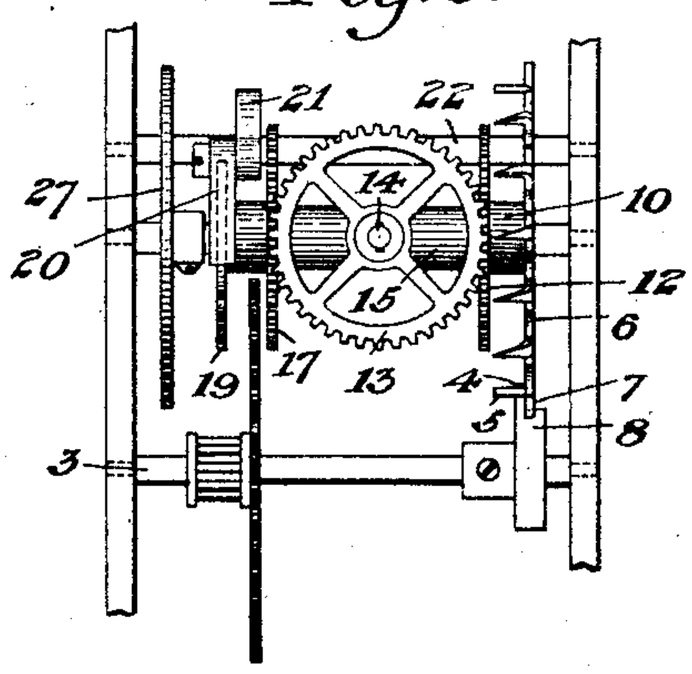


Fig. 6.



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UNITED STATES PATENT OFFICE.

ARTHUR F. POOLE, OF WASHINGTON, PENNSYLVANIA.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 631,511, dated August 22, 1899.

Application filed June 23, 1898. Serial No. 684,286. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR F. POOLE, of Washington, in the county of Washington and State of Pennsylvania, have invented a new and useful Improvement in Electric Clocks, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevation, partly broken away, showing my improved master-clock. Figs. 2 and 3 are similar views showing the parts in the successive positions which they assume in completing the circuit and actuating the secondary clocks. Fig. 4 is a side elevation of the master-clock, and Figs. 5 and 6 are detail views of a sun-and-planet mechanism employed therein.

My invention relates to the class of electric clocks wherein the master-clock through a series of electrical connections actuates the secondary clocks; and it is designed to improve the mechanism for making and breaking the circuit, so as to make the action more certain, and to provide means for actuating the secondary clocks, so as to bring them to the same point as the master-clock whenever the connections have been disarranged and the circuit not completed when desired.

To that end it consists in a new form of liquid switch, in a system of connections therefor which gives the switch a quick motion, so as to insure a proper contact between the liquid and the electrode, in a retarding mechanism for slowing up the return swing of the switch, so as to prevent danger of accidental completing of the circuit on this movement, and in the mechanism for successively completing the circuit a number of times where the current has not been strong enough to actuate the secondary clocks, so as to bring these clocks to the same point as the master-clock when the circuit is properly completed.

It also consists in the construction and arrangement of the parts, as hereinafter more fully described, and set forth in the claims

In the drawings, 2 represents an ordinary clock-train, which may be driven in any suitable manner and forms the driving mechanism of the master-clock. Upon the seconds-hand spindle 3 of this clock is secured a collar having a single tooth 4, which engages the forwardly-projecting teeth 5 of a wheel 6. From the edge of this wheel 6 there project a series of teeth 7 in the same plane therewith, which teeth normally rest upon the smooth periphery of a ring 8, secured in the rear of the collar carrying the tooth. In this ring 8 is provided a radial recess 9, which is so arranged as to allow the edge teeth of the wheel 6 to enter it, so as to allow this wheel to move when its forwardly-projecting spur-teeth are engaged by the tooth 4.

The wheel 6 is secured to a collar 10, which is loosely mounted on the shaft 11, and to this same collar is secured a toothed wheel 12, engaged by a crown-wheel 13, mounted on a stud-shaft 14, carried on the collar 15, which is secured to the shaft by a set-screw 16. This crown-wheel engages another toothed wheel 17, secured to a collar 18, having a ratchet-wheel 19 engaged by pawl 20. The pawl 20 is pivotally mounted at the upper end of a swinging lever 21, secured to a shaft 22, to which shaft is secured the armature 23 of an electromagnet 24, rigidly secured upon the base of the clock. This magnet is so wound that when the magnets in the secondary clocks are energized this magnet will attract its armature. A spring 25, connected to the lever, normally swings the same toward the right, so as to withdraw the armature from the magnet and force the pawl 20 into engagement with the teeth of the ratchet-wheel and also into contact with an adjustable set-screw 26, which serves to jamb the pawl against the bottom of the ratchet-wheel tooth, so as to lock the parts firmly in such position until they are released at the proper moment.

Rigidly secured to the forwardly-projecting end of the shaft 11 is a disk 27, having an inclined-edge recess 28, normally engaged by a pin 29, mounted upon a lever 30, secured to a shaft 31, to which shaft is secured a hook-lever 32, which normally engages a pin 33, secured to an arm 34, mounted on a shaft 40, upon which is also mounted the switch 35. This switch consists of a short glass tube, through the bottom of which extend two platinum wires 36, which are sealed therein and form electrodes. A small quantity of mercury is placed in the tube, and the air being exhausted therefrom the end of the tube

is sealed up, so as to prevent oxidation of the mercury, which would result if air were allowed to remain in the chamber. Instead of exhausting the air from the sealed tube the tube may be filled with a gas which will not combine chemically with the mercury—such for instance, as nitrogen—and I intend to cover this switch in either of such forms in combination with the retarding mechanism hereinafter described. From the electrodes 36 lead the flexible coiled wires 37 to binding-posts 38 and 39. From one of these binding-posts a wire leads to the electromagnet 24, while the other is connected to the line-wire.

Upon the shaft 40 is secured a counterpoise 41, which partially counterweights the switch, and to this same shaft is secured a segment of a ratchet-wheel 42, engaged by a pawl 43, secured to shaft 44, which carries a lever 45, having a lateral pin 46. The lever 45 is swung in one direction by a lever 47, which contacts with the pin 46, this lever 47 being loosely mounted upon a shaft 48 and having two oppositely-projecting arms 49 and 50. The arm 49 is connected by a spring 51 with a lever 52, rigidly secured to the shaft 48, the collar 53 of the lever 52 having a pin 54, which contacts with the lever 47 and acts as a stop for its backward movement. In the lever 52 is mounted a short shaft, to which is pivotally connected a link 55, which at its other end is pivotally connected to a bell-crank lever 56, upon the other arm of which is carried the armature 57 of the main electromagnet 58. A spring 59, connected to the bell-crank, tends to normally draw the armature away from the magnet.

The arm 50 of the lever 47 is pivotally jointed to a small cylinder 60, which reciprocates over a pivoted plunger 61 and acts as a dash-pot for the movements of the lever 47.

62 is a stop-pin which limits the movement of the lever 47 in one direction and also regulates the throw of the switch by contact with a short arm 63, secured to the shaft upon which the switch is mounted.

The electrical connections are as follows: From the positive pole of the battery 64 the wire 65 leads to the binding-post 39 and thence to one of the electrodes in the switch. From the other electrode the wire 37 leads to the binding-post 38, from which the wire 66 leads to the electromagnet 24, from which magnet the wire 67 leads, through the binding-post 68, to the electromagnet 58, from which the wire 69 leads to and through the secondary clocks 70, and thence back to the negative pole of the battery.

The operation is as follows: Starting with the parts in a normal position, as shown in Fig. 1, at any suitable interval, which I have shown as one minute, though any other interval may be used, the pin upon the spindle of the seconds-hand engages a tooth upon the wheel 6 and moves this wheel in a counter-clockwise direction one tooth, this being allowed by the edge tooth of this wheel entering the recess in the ring 8. The wheel 6, through the planet-wheel connection, swings the disk 27 so as to lift the pin 29 out of the recess in the disk, thus swinging the shaft 31 and hook-lever 32 so as to release this hook-lever from the pin 33, as shown in Fig. 2. The counterweight being of less weight than the switch, the switch then swings downwardly into horizontal position, being stopped by the pin 62. The mercury in the tube then covers both of the electrodes 36 and establishes connection between them, whereupon the current passing through the circuit throws the parts into the position shown in Fig. 3, the armatures of both magnets being drawn to these magnets. The bell-crank lever 56 as it swings under the influence of the magnet elongates the spring 51, which, acting upon the arm 49, swings the lever 47. As this lever swings under the influence of the spring its pin 47′ contacts with the lever 34 and swings this lever back to and beyond its normal position, this movement being slowed up and regulated by the dash-pot 60, so as to prevent an irregular completion of the circuit by splashing of the mercury and also to prolong the completion of the circuit sufficiently to insure the necessary impulse for the secondary clock. This slowing-up or retarding device is an important part of my invention, and I intend to claim a switch comprising a tube containing the conducting liquid and having electrodes, this tube being swung in one direction by an electromagnet, in combination with the retarding device, whether used with the other mechanism shown or with other forms of electric clocks. The amount of mercury in the tube and the position of the tube are so adjusted that as the lever 34 swings back the circuit will not be broken until after the pin 33 has moved to a point where it will be positively engaged by the hook-lever 32 and is swung a sufficient distance beyond this position to insure the mercury flowing away from one electrode and breaking the circuit. As the mercury possesses a high surface tension, the tube may be tipped somewhat in either direction before the mercury begins to flow, and when it starts it moves very rapidly. I therefore, as above described, swing the lever 34 somewhat beyond its normal position to insure breaking the contact, and this arm may then tilt back slightly to the normal position shown in Fig. 1 without completing the circuit. As the lever 47 is swung back by the spring connection with the bell-crank lever it releases pin 46, and consequently allows the pawl 43 to drop and engage the segmental ratchet 42. During this return swing of the lever 47, also immediately upon the mercury leaving the one electrode in the tube, the circuit being broken, the armatures of the magnets are released and the spring 59, drawing upon the bell-crank 56, swings this bell-crank until the pin 54 contacts with the lever 47 and prevents further movement of the lever 47 relatively to the lever 52. Thereafter this

system of levers moves back under the influence of the spring 59 to its normal position, this movement again being slowed up and regulated by the dash-pot. As the bell-crank lever 56 moves back under the action of its spring the lever 21 is swung toward the right by the spring 25, and through the pawl 20 moves the ratchet-wheel 19 in a clockwise direction and moves the disk 27 by means of the interposed planet mechanism, so as to bring the recess in this disk into registry with the pin 29, which again drops into the recess, leaving these parts in their original position, the hook-pawl 32 dropping in the path of the pin 33. The lever 47, which has been slowly moving back to its normal position, then lifts the pawl 43 out of contact with the segmental ratchet by means of the pin 46 and the lever 45, the arm 34 falls to the left until the pin 33 engages the hook-lever 32, and the parts all return to their normal original position.

I will now describe the operation of the mechanism which, in case the necessary currents are not given to the secondary clocks, the master-clock will, when sufficient current is given, continue to give impulses to the secondary clocks until these clocks are brought to the same point as the master-clock. It is evident that as long as the hook-lever 32 is in lifted position the master-clock will continue to send out a succession of impulses, since in such case the arm 34 will not be stopped by this hook-lever, but will swing to the extreme left so as to close the circuit. Assuming that the necessary current is not given to the secondary clocks with the parts arranged as shown, the clock mechanism of the master-clock will move the toothed wheel 6 a distance of one tooth every minute. Consequently the disk 27, by means of the connected planet mechanism, will move one-half of this distance, the pin 29 riding on the periphery of this disk. This disk being normally turned back by means of the electromagnet 24 the same distance that it is moved forward by the clock mechanism, if the clock mechanism has moved the wheel 6 more than one tooth the electromagnet must act a corresponding number of times in order to move the disk back to a point where the pin will engage this recess. Consequently if the clock mechanism drives the wheel 6 a distance of, say, five teeth, there being insufficient current given to the secondary clocks for a period of five minutes through imperfect contact or for any other reason, the electromagnet 24 will continue to act when good contact is again made until the pin 29 enters the recess, which will necessitate five impulses from this magnet. These impulses will of course follow each other in a quick succession until the number of currents sent out are made equal with the minutes that have elapsed. I therefore term this mechanism an "equalizing" mechanism, and by this term intend to cover any mechanism which will automatically actuate the secondary-clocks and bring them to the same point as the main clock after the interval of inaction irrespective of its length. It is evident, therefore, that no matter how long the master-clock may operate without giving sufficient current to the secondary clock within the limits of the peripheral length of the disk when sufficient current is given the electromagnet 24 will continue to give a succession of impulses, which will move the secondary clock to the same point as the master-clock, whereupon the pin 29 will enter the recess 28 and the impulses will stop, the action then becoming normal again. The magnet 24 is energized by the same current as the secondary clocks and requires the same amount of current as do the magnets of the secondary clocks.

The advantages of my invention result from the use of the peculiar switch described, which will not deteriorate in continued use, from the peculiar connections between the actuating-magnet and this switch, which gives it a quick movement closing the circuit, and a slow regulative return movement, which insures a sufficient duration of the current and prevents irregular completions of the circuit. The mechanism for bringing the secondary clocks to the same point as the master-clocks where sufficient current is not imparted at the desired time is of great advantage, as it does away with the necessity of resetting each secondary clock in the system whenever the impulses are not imparted to the secondary clocks at the desired times through any cause—such as imperfect contact, renewing the battery, or repairing one of the secondary clocks.

Many changes may be made in the form and arrangement of the parts without departing from my invention, since

I claim—

1. In an electric clock, a switch consisting of a tube containing a conducting liquid, said tube having electrodes projecting thereinto, a clock mechanism arranged to swing the tube in one direction, an electromagnet arranged to swing the switch in the opposite direction and a retarding connection between the magnet and the switch arranged to slow down the movement and prevent splashing of the mercury and irregular completion of the circuit; substantially as described.

2. In an electric clock, a switch consisting of a tube containing a conducting liquid and having electrodes projecting thereinto, a clock mechanism arranged to swing the tube in one direction, an electromagnet arranged to swing the tube in the opposite direction, and a dash-pot mechanism arranged to slow down the return movement of the switch and prevent splashing of the mercury and irregular completion of the circuit; substantially as described.

3. In an electric clock, a switch comprising a tube containing a conducting liquid and having electrodes projecting thereinto, a

clock mechanism arranged to swing the tube in one direction, an electromagnet arranged to swing the tube in the opposite direction, a spring interposed in the connections between the magnet-armature and the switch, and a dash-pot mechanism arranged to slow down the return movement of the switch under the action of the spring; substantially as described.

4. In an electric clock, a switch consisting of a tube containing a conducting liquid and having electrodes projecting thereinto, a swinging support for the tube, a stop connected with the clock mechanism and acting upon the support to normally hold the tube in tilted position, and means for tilting the stop to release this support at determined intervals; substantially as described.

5. In an electric clock, a switch consisting of a tilting support, a switch mounted thereon and consisting of a tube containing a conducting liquid and having electrodes projecting thereinto, a stop which normally engages the tilting support, and holds the switch in inclined position, a clock mechanism arranged to engage the stop and release the holder at determined intervals, and an electromagnet arranged to return the switch to its tilting position; substantially as described.

6. In a system of synchronized clocks, a master-clock having suitable connections with a series of secondary clocks, and arranged to give impulses thereto at determined intervals, electromagnets in the secondary clock and an electromagnet in the master-clock through which the impulse passes through the secondary clocks, said magnet being arranged to be operated by the same amount of current which will operate the secondary clocks; substantially as described.

7. In a system of synchronized clocks, a master-clock having connection with a series of secondary clocks arranged to give electric impulses to them at determined intervals, electromagnets in the secondary clocks, an electromagnet in the master-clock arranged to return the switch to its normal position, and another magnet in the master-clock arranged to be operated by the same amount of current which will operate the secondary clocks, and an equalizing mechanism connected to the latter magnet and operated thereby, substantially as described.

8. In a system of synchronous clocks, a master-clock having an equalizing mechanism which is actuated in one direction by the clock mechanism, and mechanism operated by the electromagnet which actuates the secondary clocks, and arranged to operate the equalizing mechanism in the opposite direction; substantially as described.

9. In a system of synchronized clocks, a master-clock having a switch, an electromagnet arranged to control the movement of the switch in one direction, a stop which when released allows the switch to swing in the other direction, a connection between the stop and the clock mechanism arranged to operate the stop at determined intervals, an equalizing mechanism actuated by the clock mechanism at each release of the stop, and an electromagnet arranged to move the equalizing mechanism in the opposite direction whenever sufficient current is supplied thereto; substantially as described.

10. In a system of synchronized clocks, a master-clock having a switch mechanism, an electromagnet arranged to control the movement of the switch in one direction, means for swinging the switch in the opposite direction, an equalizing mechanism operated at determined intervals by the clock mechanism of the master-clock, and a second electromagnet arranged to actuate the means which permits the switch to make and break the circuit continuously until the equalizing mechanism has returned to its normal position; substantially as described.

11. In a system of synchronized clocks, mechanism connected with the clock mechanism of the master-clock and arranged to control movement of the switch in one direction to close the circuit at determined intervals, an equalizing mechanism operated by the clock mechanism at the same intervals, and an electromagnet having a stop or lock mechanism which controls the circuit-closing mechanism, said electromagnet being arranged to hold the stop or lock open so as to give a succession of impulses to the secondary clocks until the equalizing mechanism has returned to its normal position; substantially as described.

12. In a system of synchronized clocks, a master-clock having a switch, mechanism between the switch and the clock mechanism arranged to control movement of the switch in one direction to close the circuit at determined intervals, an equalizing mechanism operated by the clock at the same intervals, a stop or lock for the switch, closing mechanism controlled by the equalizing mechanism and an electromagnet arranged to give successive impulses to the secondary clocks and connected to the equalizing mechanism to return it to its normal position and lock the circuit open; substantially as described.

13. In a system of synchronized clocks, a master-clock having a switch, connections between the switch and the clock mechanism arranged to control movement of the switch in one direction to close the circuit at determined intervals, an equalizing mechanism operated by the clock at the same intervals, a stop or lock for the switch, closing mechanism controlled by the equalizing mechanism and an electromagnet arranged to operate the equalizing mechanism to return it to its normal position and lock the switch open, said magnet being wound so as to be operated by the same amount of current which will actuate the magnets of the secondary clocks; substantially as described.

14. In a system of synchronized clocks, a

master-clock having an equalizing mechanism which is actuated in one direction by the clock mechanism and mechanism operated by the motive power actuating the secondary clocks and arranged to operate the equalizing mechanism in the opposite direction; substantially as described.

In testimony whereof I have hereunto set my hand.

ARTHUR F. POOLE.

Witnesses:
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E. SMITH.