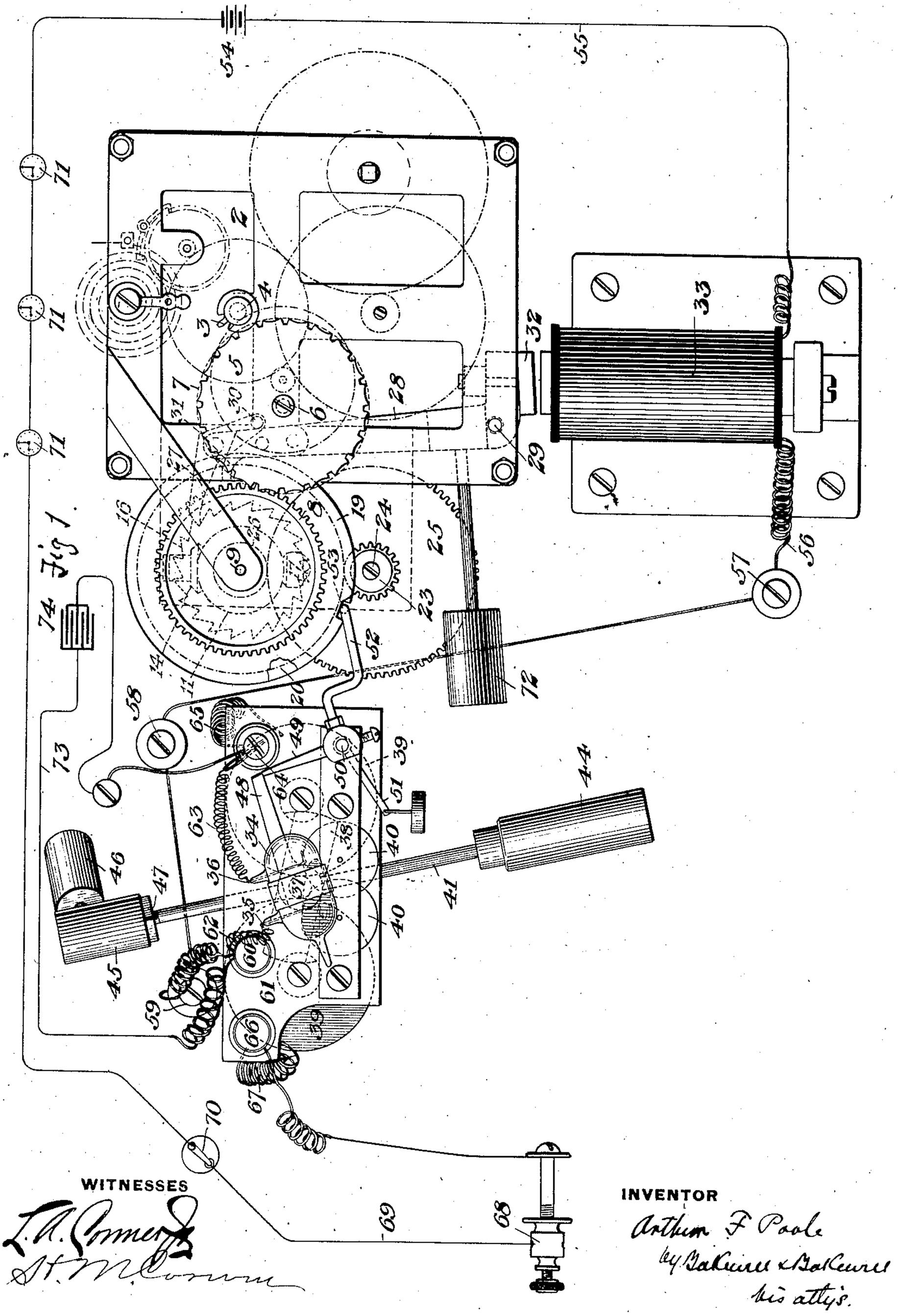
No. 834,995. PATENTED NOV. 6, 1906.

A. F. POOLE.

ELECTRIC CLOCK.

APPLICATION FILED DEC. 6, 1900.

3 SHEETS—SHEET 1.



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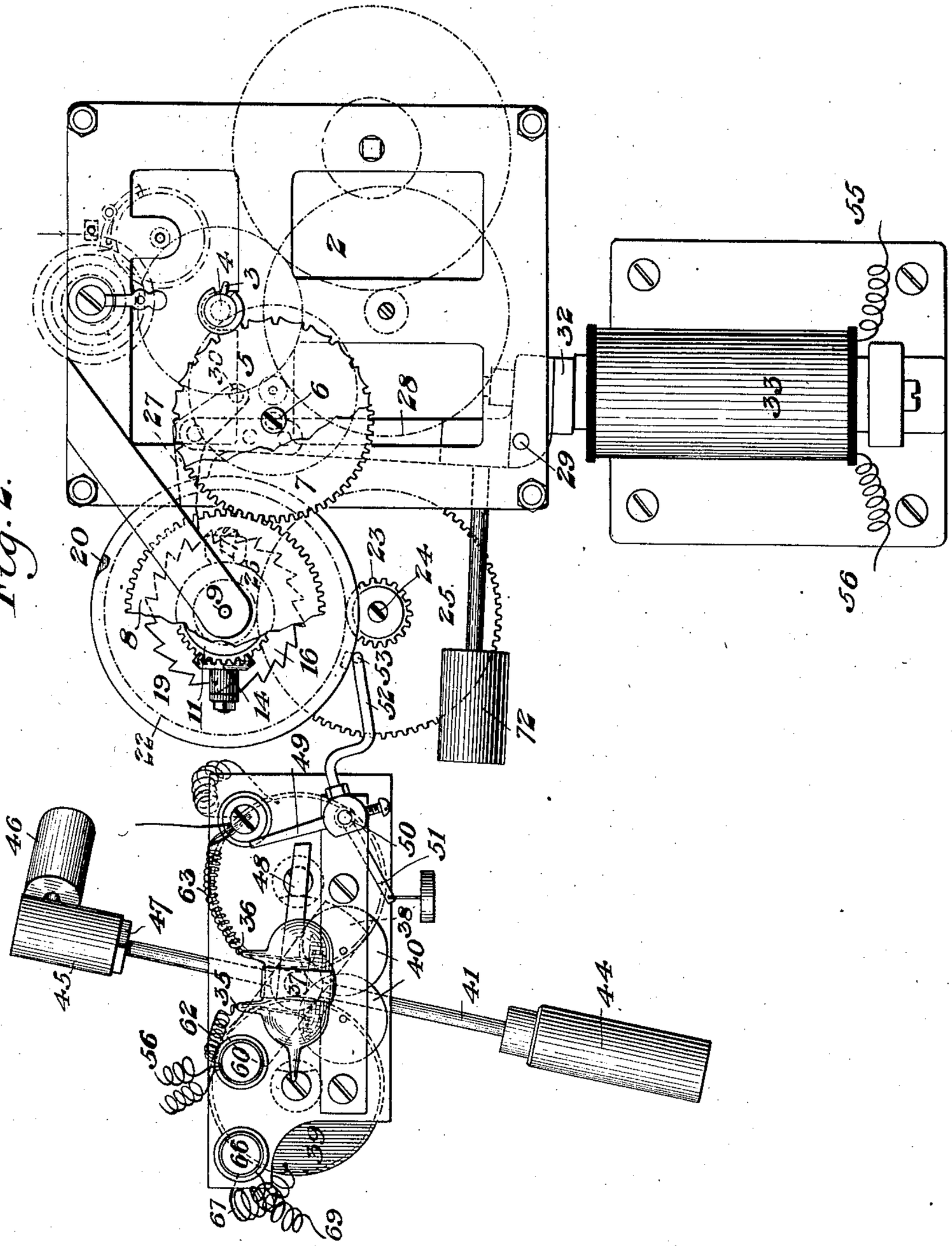
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

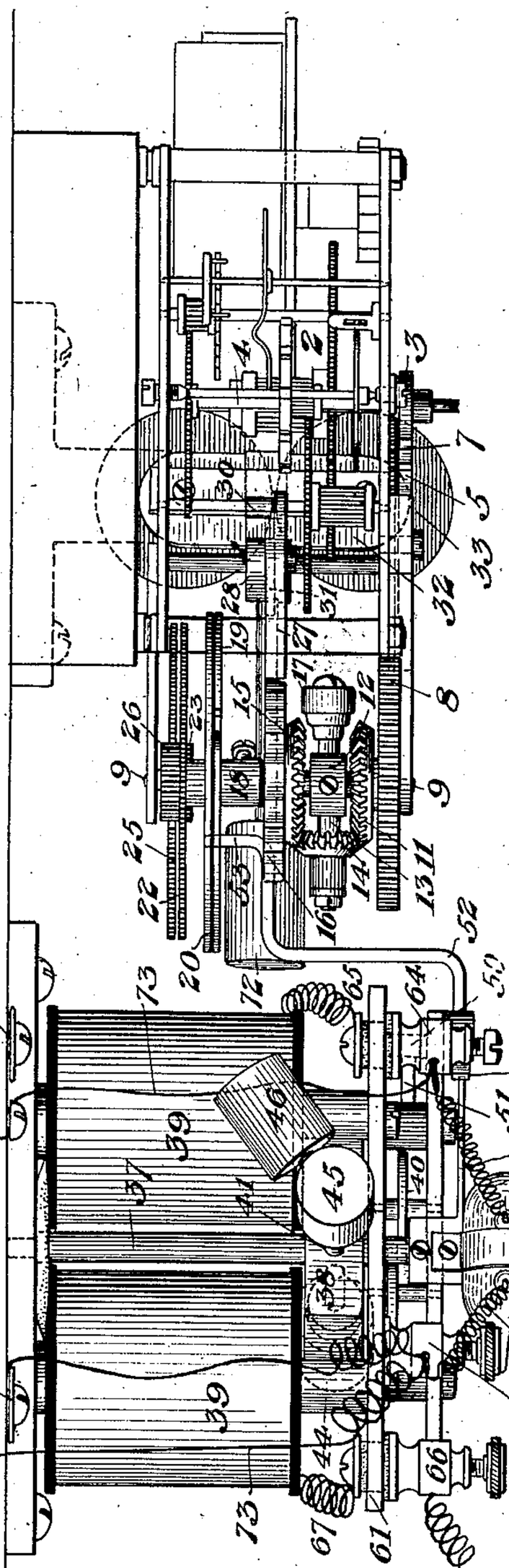
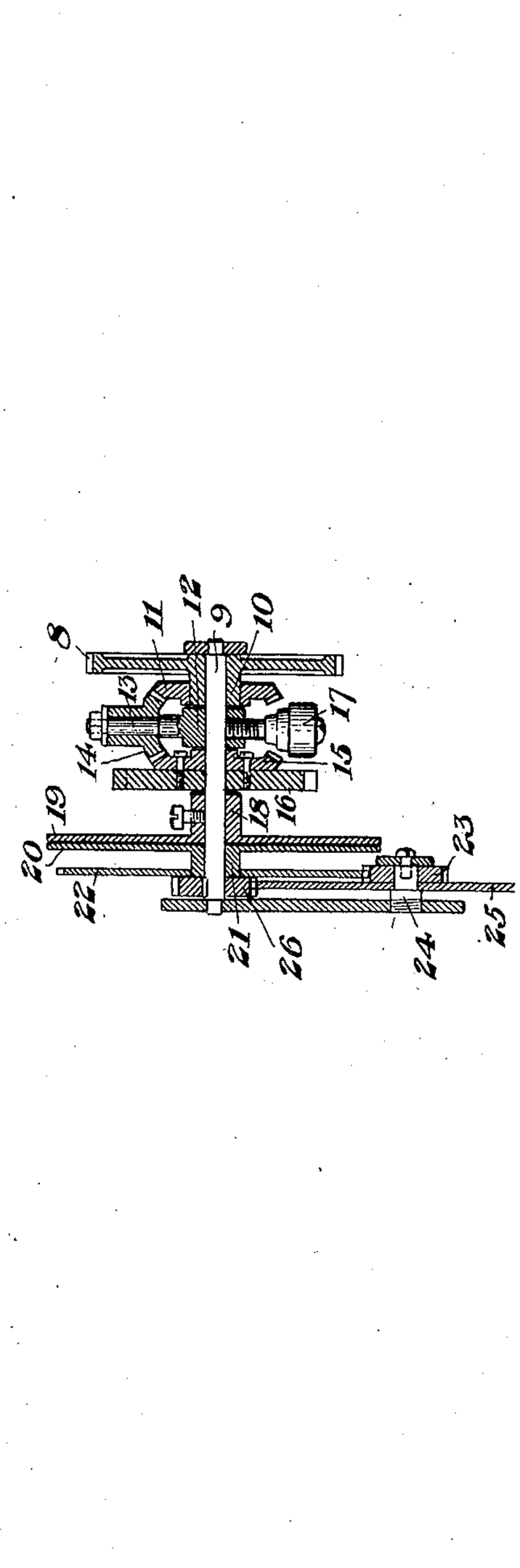


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRIC CLOCK.

No. 834,995. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed December 6, 1900. Serial No. 38,915.

To all whom it may concern:

Be it known that I, ARTHUR F. POOLE, of Wheeling, in the county of Ohio, and State of West Virginia, 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 of my improved master-clock. Fig. 2 is a similar view, partly broken away, showing the parts in a different position. Fig. 3 is a top plan view of the clock, and Fig. 4 is a sectional elevation showing the equalizing mechanism hereinafter referred to.

My invention relates to the class of electric clocks wherein the master-clock actuates a series of secondary clocks electrically, and more particularly to the clock set forth in my Patent No. 631,511, dated August 22, 1899.

The invention is designed to simplify the mechanism of the master-clock and enable it to bring the secondary clocks to the same point of the master-clock no matter what amount of time has elapsed since they were actuated, to prevent deterioration of the mercury switch by the use of a condenser, to prevent sparking therein, and to do away with the dash-pot and lever systems for slowing up the return movement of the switch and provide a simple pendulum device for such purpose.

In the drawings, 2 represents an ordinary clock mechanism, which may be driven in any suitable manner and forms the driving mechanism of the master-clock. A collar 3 having a single tooth thereon is secured to the seconds-hand spindle 4 of this clock, and this tooth engages the teeth of a mutilated toothed wheel 5, which I have shown as having twenty teeth, and is secured to a stud-shaft 6, which carries a toothed wheel 7. The wheel 7 intermeshes with a toothed wheel 8, which is loosely mounted upon a spindle 9 and has a hub 10, to which is secured a bevel-wheel 11. On the shaft 9 and rigidly secured to it is a collar 12, carrying a radial stud-shaft 13, on which is loosely mounted a bevel-wheel 14, intermeshing with the bevel-wheel 11 and also with a bevel-wheel 15 of the same size as wheel 11 and rigidly secured to a ratchet-wheel 16, loosely mounted upon the shaft 9. A counterweight 17 is secured to the collar 12 and extends in the opposite direction from the stud-shaft 13.

In the rear of the ratchet-wheel 16 is a hub 18, rigidly secured to the shaft 9 by a set-screw, as shown, and carrying a disk 19, which revolves with the shaft. This disk is provided with a notch in its periphery, which is arranged to register in certain positions with a notch in another disk 20, which is loose on the shaft 9 and has a hub 21, carrying a toothed wheel 22, engaging a pinion 23, loosely mounted on a stud-shaft 24 and having rigidly connected to it a toothed wheel 25, which engages a pinion 26, secured rigidly to the shaft 9. As the disk 19 is secured to the shaft 9, while the disk 20 is connected with the shaft by said reducing gearing, the disk 20 will rotate much slower than the disk 19, and in the form shown I have made their relationship as one to eighteen, though this may be changed as desired. The disk 20 is also provided with a peripheral notch, which in this disk is provided with square ends, while the notch in the disk 19 is provided with an inclined surface at one side leading to the periphery of the disk.

It will be noted that the disks 19 and 20 may be moved by actuating either of the beveled wheels 11 and 15 and that the movement of one of these wheels will actuate the disk without interfering with its simultaneous movement by the other wheel. The movement of the disk therefore will be in the nature of a differential between the movements of the two bevel-wheels 11 and 15. The wheel 11 is moved by the clock mechanism, while the wheel 16 is moved by a pawl 27, pivotally mounted on a bell-crank lever 28, secured to a shaft 29, carried in the frame of the clock. The pawl is limited in its movements in both directions by means of pin 30 thereon, which contacts with the lever, and a stop 31 projecting forwardly from the lever. The other end of this bell-crank lever carries the armature 32 of an electromagnet 33, which actuates the lever, and thereby the ratchet-wheel, in a counter-clockwise direction. The ratchet-wheel 16 is provided with the same number of teeth as the mutilated wheel 5. It will therefore be seen that at each minute the clock mechanism through the wheel 5 will move the disk 19 a determined distance in a clockwise direction, and that at each impulse sent through the magnet 33 the disk 19 will be moved exactly the same distance in a counter-clockwise direction, and that if the electromagnet is not actuated to thus give the reverse movement to

the disks they will go on turning, and if the notches in them are in registry at any minute they will not again be in registry until twelve hours have elapsed.

Passing now to that portion of the mechanism arranged for sending out the impulses to the secondary clocks the switch consists, as in my patent above referred to, of a short glass tube 34, having sealed ends and through the top of which extend two sealed platinum wires 35 and 36, forming electrodes. A small quantity of mercury is placed in the tube, the air is exhausted, and the tube then sealed up to prevent oxidation of the mercury, or the tube may be filled with an inert gas. This switch is secured to a rock-shaft 37, having also rigidly secured thereto an armature 38, with curved ends arranged to rock between the poles of an electromagnet 39. The front end of the rock-shaft 37 is mounted on a pair of friction-wheels 40, which are essential to give an easy movement of the shaft.

To slow up the return movement of the shaft 37, I provide a pendulum 41, consisting of a pair of rods secured in endwise alinement by screwing them to the armature, each having at its end a counterweight, numbered 44 and 45, respectively. The lower weight 44 is heavier than the weight 45, and an adjustable weight 46 is secured to the weight 45. The counterweight 45 is secured to its rod by a screw-thread connection, so that the center of gravity of the pendulum may be changed by turning it on the rod. It is secured in adjusted position by a lock-nut 47.

An arm 48 projects from the shaft 37 of the switch and is normally held in the position shown in Fig. 1 by a detent 49, secured to a small shaft 50, having a counterweighted arm 51. Secured to the same shaft and projecting in the opposite direction from the arm 51 is a tailpiece 52, having a pin 53, which is arranged to engage the notches in the disks 19 and 20 when the said notches are in registry.

Referring now to the electrical connections, 54 represents the battery, having one wire 55 leading directly to the electromagnet 33. From the magnet 33 the wire 56 leads through the posts 57, 58, and 59 to binding-post 60, secured to the frame 61 and insulated from said frame. From the post 60 a flexible wire 62 leads to the electrode 35 of the switch. The other electrode 36 is connected by flexible wires 63 to a binding-post 64, also mounted on and insulated from the frame. From this binding-post a wire 65 leads through the electromagnet 39 to binding-post 66, insulated from the frame, from which the wire 67 leads to outer binding-post 68, from which wire 69 leads through a switch 70 to the system of secondary clocks 71 and thence back to the battery.

It will be evident that with the connections as referred to the pendulum is normally held in the position shown in Fig. 1 by the detent 49, the circuit being broken only through the switch 34, and whenever the detent is swung to one side the switch and pendulum will swing into the position shown in Fig. 2 and close the circuit. As soon as this takes place the current passing through the electromagnet 39 will cause a pull on the armature 38 and tend to restore the switch to its normal position, as shown in Fig. 1. This return movement will be slowed up by reason of the resistance offered by the counterweights on the pendulum, which thus prevent a rapid motion and irregular working of the switch. As the magnet thus pulls upon the armature it breaks the circuit, the momentum of the weights carrying the arm 48 slightly above the position shown in Fig. 1, and the pendulum will then start to swing back into the positior of Fig. 2. This movement will take place unless the detent is in position to engage the arm, and it is evident that if the detent is held out of engaging position the pendulum will continue its movements, sending out successive impulses to the secondary clocks. The operation of the master-clock is therefore as follows: Starting with the parts in normal position, as shown in Fig. 1, at suitable intervals, which I have shown as one minute, though other intervals may be used, the tooth upon the seconds-hand spindle actuates the wheel 5, and thereby through the sun-and-planet gear moves the disk in a clockwise direction, the movement of the disk 20, however, being inappreciable. As the disk 19 is thus moved the pin 53 of the tailpiece 52 rides up the incline at one side of the notch and rests upon the periphery of the disk 19. The shaft 50 is thus swung to the right, causing the detent to be drawn from under the arm 48 and allowing the pendulum to swing in the manner above described, carrying the switch with it. As the circuit is thus completed through the switch both the magnets 39 and 33 are energized and act upon their respective armatures. The electromagnet 39 thereupon exerts a pull upon the armature 38, which tends to swing the pendulum back and break the circuit, and at the same time magnet 33, through lever 38, draws back the pawl 27 into position to move the ratchet-wheel one tooth ahead as soon as the armature is released. When the pendulum reaches a certain point in its movement, the circuit is broken by the mercury flowing away from the wire 36, and the armature 32 is thus released, while the pendulum continues a further movement in the same direction. As soon as the lever 28 is thus released a counterweight 72 forces the lever forward and causes the pawl to drive the ratchet-wheel one tooth ahead. This motion through the sun-and-

planet mechanism returns the disks 19 and 20 to their original position, the pin 53 drops into the notch of disk 19, and the counter-weighted arm 51 swings the detent back into its position. This occurs before the arm 48 reaches the position shown in Fig. 1 and after the additional movement which is caused by the momentum of the weights, and the detent therefore engages the arm 48 and the parts resume their normal position.

I will now describe the operation of the mechanism in a case where the necessary currents are not given to the secondary clocks and by which the master-clock when a sufficient current is given will impart a succession of impulses to the secondary clocks until they are brought to the same point as the master-clock.

The current which passes to the secondary clocks passes through the electromagnet 33, and if this current is too weak to operate them it will not operate the lever 28, and hence the counter-clockwise motion of the disks is not imparted. As long as this condition continues the pin 53 rides on the periphery of the disk 19, and the notches in the two disks will continue out of registry. If the current does not pass for twelve hours, at the end of this time the notches will again be in registry and in position to receive the pin 53. When the circuit is completed, the pendulum will begin to swing, sending out the impulses to the secondary clocks, and as the detent 49 is held out of position to engage the arm 48 the successive impulses will be given until the operation of the ratchet-wheel, by means of the magnet 33, has turned the disks back to a position where their notches register, as shown in Fig. 1. The number of these impulses will evidently be exactly the same as the number of minutes which have elapsed since the current was last completed, and I therefore term the general mechanism shown as consisting of the disks and their connections, an "equalizing" mechanism, as in my patent above referred to. As soon as the notches again register the normal operation will again be resumed. The current is normally strong enough to actuate the secondary clocks, and an important function of the mechanism is to correct the secondary clocks when through any cause an abnormal condition arises and the current becomes too weak to operate them. The current is of course made and broken every minute under normal conditions, and under these conditions the impulses actuate every secondary clock. The same switch mechanism actuates the pendulum in the manner before described by making and breaking the circuit, since when it closes the circuit the electromagnet will swing the switch to its normal position, as shown in Fig. 1.

The remaining feature of my invention lies in the means for preventing sparking at the breaking of the circuit. This difficulty has arisen in all electric-clock systems, especially those containing a large number of secondary clocks. Where contacting electrodes are used, this sparking corrodes the electrodes and renders it necessary to use a considerable power to wipe them clean, and in a mercury switch, such as shown, the spark would volatilize the mercury and cause it to deposit upon the glass between the electrodes and eventually short-circuit the connections. To obviate this difficulty, I provide a simple automatically-acting device which does not increase the cost of operating and effectually prevents this trouble. It consists in the use of a condenser in a shunt-circuit extending across the break of the switch. Thus in Fig. 1 I show a shunt-circuit 73, extending between the binding-posts 60 and 64 and containing a condenser 74 of any usual type. I find that by the use of this simple extra circuit the sparking between the electrodes is avoided.

The advantages of my invention will be apparent to those skilled in this art. The new arrangement of the equalizing mechanism enables the master-clock to bring the secondary clocks into synchronism therewith irrespective of their positions. This not only provides for the automatic correction of every clock in the system, but also enables the secondary clocks to be cut out of the circuit through the night or through such times as they are not used, the master-clock automatically correcting them as soon as the hand-switch 70 is closed. This saves in the cost of operating the battery and can be easily carried out by the use of a hand-switch. The new arrangement of the slowing-down mechanism for the switch greatly simplifies and cheapens the construction and renders it less liable to get out of order, as there is only one moving shaft in this part of the apparatus, this shaft carrying both the switch and the moving part of the slowing-down mechanism. The adjustable counterweight on the pendulum further provides for adjusting the action of the slow-down device. As the magnet of this portion of the mechanism acts directly on the part carrying the switch, the time of contact will vary inversely with the strength of the current. This introduces a saving, since if the current is strong it will swing the switch quickly, and thus reduce the time of each contact. If the battery becomes weak, the contact will be correspondingly longer, and thus automatically compensate for the difference in the strength of the current. The advantage of the condenser is apparent, since it avoids the deterioration of the electrodes and is of especial advantage in connection with the mercury switch shown.

Many variations may be made in the clock

mechanism and the form and arrangement of the other parts without departing from my invention.

I claim—

1. In a system of synchronized clocks, secondary clocks, a master-clock having an equalizing mechanism, mechanism operated by the motive power actuating the secondary clocks, and arranged to operate the equalizing mechanism in one direction, and a clock mechanism arranged to actuate the equalizing mechanism in the opposite direction and to return said equalizing mechanism to its normal position once in twelve hours, or a multiple thereof; substantially as described.

2. In a system of synchronized clocks, secondary clocks, a switch controlling the impulses to the secondary clocks, a master-clock having an equalizing mechanism containing two disks which in a certain relative position thereof are arranged to stop the movement of the switch controlling the impulses to the secondary clocks, clock mechanism arranged to move said disks at different rates of speed in one direction, and mechanism operated by the motive power actuating the secondary clocks and arranged to turn the disks in an opposite direction at varying rates of speed; substantially as described.

3. In a system of synchronized clocks, secondary clocks, switch mechanism controlling the impulses to the secondary clocks, a pair of disks having registering notches, a lever acted upon by the notches, and controlling the switch mechanism for the impulse-currents, a clock mechanism arranged to turn the said disks in one direction at different rates of speed, and mechanism operated by the motive power which actuates the secondary clocks and arranged to operate the disks in the opposite direction at varying rates of speed; substantially as described.

In testimony whereof I have hereunto set my hand.

A. F. POOLE.

Witnesses:
F. E. GAITHER,
C. P. BYNES.