(No Model.) 2 Sheets—Sheet 1.

W. K. MENNS & W. J. DUDLEY.

ELECTRIC CLOCK.

No. 457,030. Patented Aug. 4, 1891.

FIG. 1.

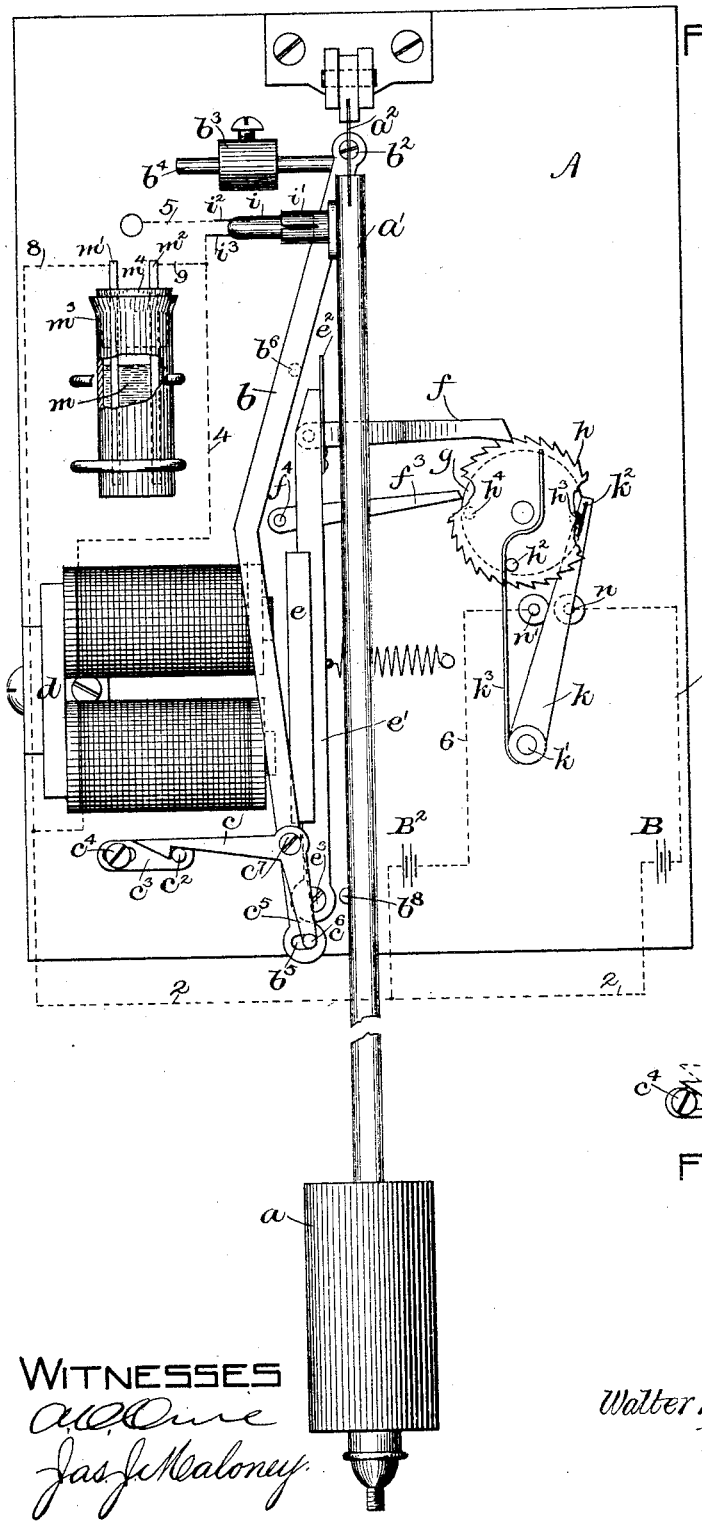


FIG. 2.

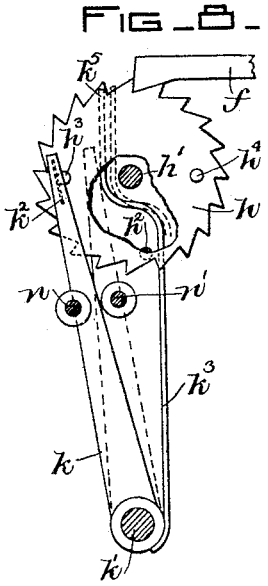
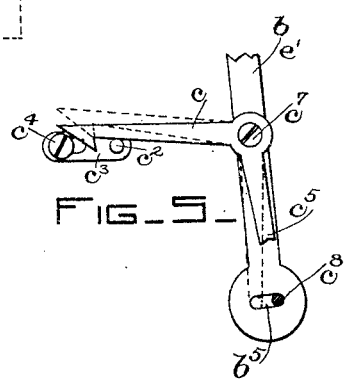


FIG. 5.



WITNESSES

A. C. Dunn

Jas. J. McAloney.

INVENTORS

Walter K. Menns & Walter J. Dudley

by Jos. P. Livermore

Att'y.

(No Model.) 2 Sheets—Sheet 2.

W. K. MENNS & W. J. DUDLEY.

ELECTRIC CLOCK.

No. 457,030. Patented Aug. 4, 1891.

FIG. 2.

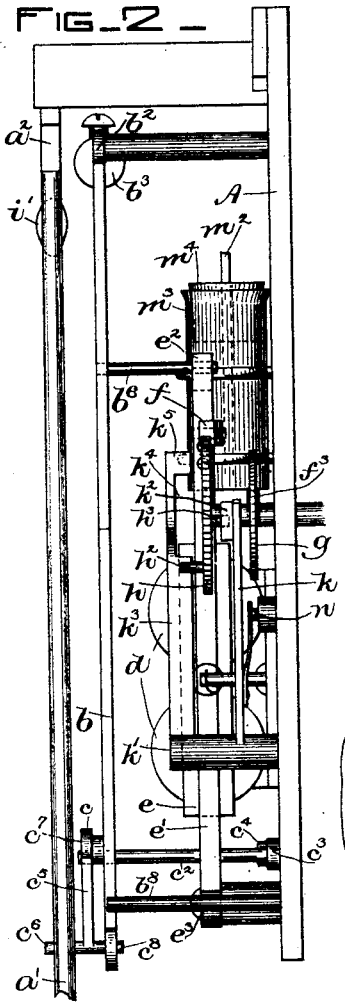


FIG. 3.

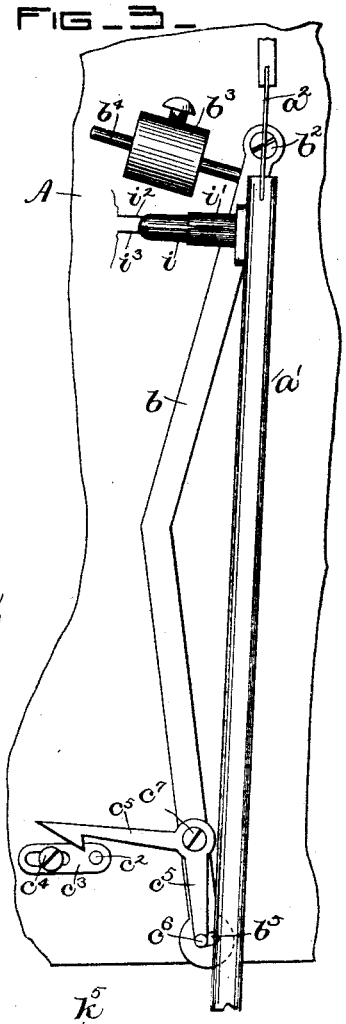
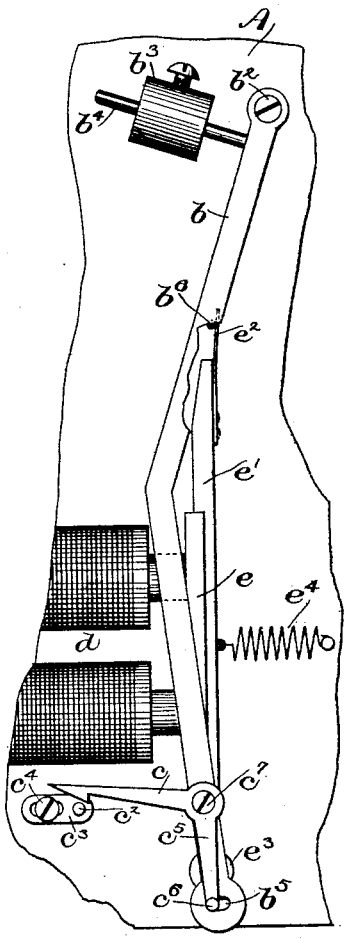


FIG. 4.



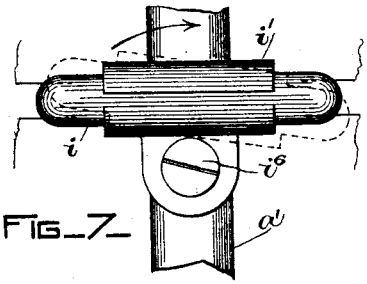


FIG. 7.

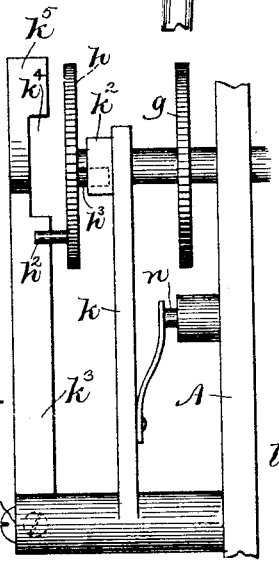


FIG. 9.

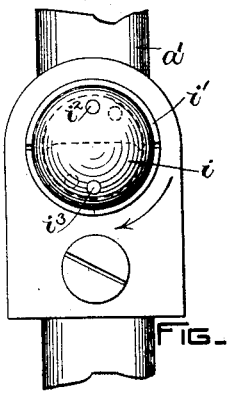


FIG. 6.

WITNESSES

Jas. J. Mealoney.

INVENTORS

Walter K. Menns & Walter J. Dudley

by Jno. P. Livingston

Att'y.

UNITED STATES PATENT OFFICE.

WALTER K. MENNS AND WALTER J. DUDLEY, OF EVERETT, MASSACHUSETTS, ASSIGNORS TO THE WALTHAM ELECTRIC CLOCK COMPANY, OF NEW HAMPSHIRE.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 457,030, dated August 4, 1891.

Application filed March 8, 1890. Serial No. 343,133. (No model.)

To all whom it may concern:

Be it known that we, WALTER K. MENNS, a British subject, and WALTER J. DUDLEY, a citizen of the United States, both residing in Everett, county of Middlesex, and State of Massachusetts, have invented an Improvement in Electric Clocks, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to an electric clock of that class in which a time-measuring pendulum controls in its vibrations the circuit of an electro-magnet, which in turn actuates an impelling device by which an impulse is given to the pendulum and its oscillating movement thus maintained for an indefinite period of time. The impulse is herein shown as derived from the force of gravity, the impelling device consisting of a pivoted arm arranged to bear by its weight against the pendulum during a portion of its vibratory movement in one direction, the said arm being raised or restored to its normal position before the return movement of the pendulum by the armature-lever of an electro-magnet. This magnet is shown as being of the ordinary horseshoe type and is in a circuit controlled by the pendulum, which has circuit breaking and making devices thereon. The impelling device is supported or held in its highest position by a catch or movable detent member pivoted on the impelling device and co-operating with a stationary detent member, (shown as a pin fixed on the clock-plate,) and the detent is arranged to be disengaged by the pendulum when near the end of its vibration toward said impelling device, thus leaving the impelling device supported by the pendulum-rod, so that its weight acts to impel the said rod during a portion of its vibration, after which the pendulum causes the circuit of the restoring-magnet to be closed, causing the movement of the armature-lever by which the impelling device is raised or restored to its normal position, when the catch engages the fixed pin and retains it in this raised position. The armature-lever of the magnet may also be employed to actuate hands which indicate the time measured by the pendulum, and the main or primary clock may also control any desired number of secondary clocks or dials having actuating mechanism for hands which are thus moved in unison with those of the main primary clock.

The circuit-closing device actuated by the pendulum is shown in this case as composed of a sealed glass tube partially filled with mercury attached to the pendulum-rod near its upper end and having wires projecting into the tube in such manner that the motion of the pendulum causes a rise and fall of the mercury relatively to the inwardly-projecting ends of the wires, and thus electrically connects and disconnects them. Means for adjusting this device in order to get the circuit closed properly are shown.

Means are provided for preventing the destructive sparking at the instant of breaking the circuit, consisting of a vessel containing liquid, preferably water, in which electrodes are immersed, the apparatus being included in a shunt around the magnet-coils or the contact-points, or both, although the high resistance of the liquid prevents it acting as a shunt in the way shunts have hitherto been applied to this purpose.

As open-circuit batteries are used to propel the clock, and certain varieties of these are liable to polarization and consequent weakening of the current unless allowed to remain on an open circuit occasionally, a device for alternating batteries is shown, consisting of a switch controlled by the clock and arranged by a sudden motion to cut one of the batteries in and the other out at definite intervals of time.

The invention consists, mainly, in the novel construction of the detent mechanism for supporting the impelling-weight and causing its impulse to be transmitted to the pendulum-rod when the detent is disengaged, and also to specific features of construction of the circuit-closer for controlling the restoring-magnet, and to the mechanism for operating the switches that shift the batteries in the operating-circuit, and to other details of construction, which will be hereinafter specified.

Figure 1 is an elevation of the mechanism of the main clock, as seen looking from the

rear, the circuit being indicated in diagram; Fig. 2, a side elevation of the clock mechanism. Figs. 3, 4, and 5, detail views showing the parts in different positions. Figs. 6 and 7, details of the mechanical circuit-closer, and Figs. 8 and 9 details of the battery-switch.

In Figs. 1, 4, 5, and 8 portions of the mechanism are broken away to show parts behind.

The pendulum-bob a and the rod a' may be of any usual construction, preferably being provided with means for compensation for variations in temperature, so that its vibrations will be as nearly as possible isochronous, it being shown as supported on a flexible spring a^2 in the usual manner.

The impelling device comprises an impulse-arm b, pivoted at b^2 at or near the point about which the pendulum oscillates, and a hooked catch or detent member c, pivoted at c^7 on said arm, which, when the arm is raised by the action of the armature-lever, engages by gravity with its hooked extremity the co-operating detent member, consisting of a pin c^2, fixed in a block c^3, and thereby retains said arm in its raised position. The block c^3 is secured to the back plate A of the clock by a screw c^4, and said screw passes through a slot in said block to give facility of adjustment of the pin c^2 relatively to detent-catch c. The center of gravity of the impelling device b b^3 is at one side of its pivotal point b^2, so that it tends to oscillate about the said point toward the pendulum-rod, and it is further provided with a lateral projection b^4, on which is supported a small weight b^3, which may be made to slide along the said projection, to or from said arm to vary its center of gravity.

The detent member c is provided with a finger c^5, projecting downward from the pivoted point c^7 of said detent along the impulse-arm b, and having at its lower extremity a pin c^8, projecting through a slot b^5 in the arm b, said pin and slot limiting the amount of motion of the finger c^5, and consequently of the free end of the detent c relative to the arm b. The finger c^5, furthermore, has secured to its free end the beat-pin c^6, by which the impulse is communicated from the arm b to the pendulum. When near the end of its movement to the left in Fig. 1 or toward the impulse-arm b, the pendulum-rod a' engages with the beat-pin c^6, thereby raising the detent c and freeing it from the pin c^2. The impulse-arm b presses by gravity toward the pendulum-rod a' and acts upon it by the end of the slot b^5, engaging the pin c^8 of the detent-arm c^5, so that the detent member c is prevented from engaging its stop-pin c^2 on the movement of the pendulum toward the right hand in Fig. 1, and the pendulum-rod and impulse-arm continue to move together until the arm strikes the banking-pin b^8, by which its further motion to the right is arrested. The weight of the impelling device is thus added to the said pendulum and imparts an impulse sufficient to make up for the resistance from friction and other causes to the movement of the pendulum. This impulse is imparted to the pendulum in its movement from left to right, as shown in Figs. 1 and 3, and it is necessary in order to make the impulse effective that the weight of the impelling device should be removed from the pendulum-rod before it makes its return movement. The impelling device is thus removed from the pendulum-rod and restored to its normal raised position, in which it remains held by the detent, as shown in Fig. 1, by means of an electro-magnet d and its armature e and armature-lever e', provided with an elastic finger e^2.

The magnet d is shown as included in the circuit of one or the other of two batteries B B^2, which are alternately switched into circuit by the switch k, as will be hereinafter described, and which circuit is as follows, the battery B being shown in Fig. 1 as acting: One pole of said battery B is connected from wire 2 with the terminal of the magnet d, the other terminal of which is connected by wire 4 with one member i^3 of a circuit-closer controlled by the pendulum, as will be hereinafter described, the other member i^2 of which is connected by wire 5 with the metallic frame-work of the clock, and thus with the switch-arm k, which in the position shown in Fig. 1 connects with wire 7, leading to the other pole of the battery B. The circuit for the battery B^2 is the same, except that its pole is connected by wire 6 with the other button or contact of the switch-arm k, so that when the said switch-arm is shifted the battery B^2 will be in circuit with the magnet d and the battery B in open circuit. The armature e is secured to the lever e', which is pivoted to turn at e^3, and has at its upper end a flat spring e^2 projecting beyond said end. Said spring is somewhat strained and presses against the end of the lever e', which thus forms a banking for said spring. The impulse-arm b is provided with a projection b^6, that extends across the path of the spring e^2 when said arm has given its impulse to the pendulum and rests against the banking-pin b^8, so that when the armature e' is actuated by the magnet its spring e^2 will engage the pin b^6 and carry the impulse-arm b to the left in Fig. 1 until the detent member c hooks over the pin c^2 and retains the arm raised, as hereinbefore explained. The spring e^2 has been found to be absolutely necessary, for if the rigid end of the lever e' engaged the impulse-arm directly without a yielding or elastic member interposed the action of the impulse-arm b would be too sudden and violent, and it would also require more power to work the clock. Without this elastic connection the detent frequently fails to engage, owing to the impulse-arm being thrown so violently.

A pawl f, pivoted near the free end of the lever e', actuates a wheel h step by step on the back-stroke of the armature e, and said wheel gives motion to the dial-wheels of a

clock in a well-known manner, these wheels being omitted for the sake of clearness, while a retaining-dog f^3, pivoted at f^4, has its free end brought to a sharp edge and bears against the periphery of a slightly-roughened wheel g, secured to the same arbor as the ratchet-wheel h. The dog f^3 is nearly radial to the wheel g, as shown, so that it jams wherever the wheel tends to turn backward and prevent such motion. This form of detent is very necessary if the clock has a seconds-hand, as with an ordinary ratchet and detent the necessary backlash makes the seconds-hand jump backward a little every time the armature e is attracted.

One of the most frequent causes of failure of electrically-impelled clocks is the destruction or fouling of the contacts by sparking, and both condensers and shunts have been employed to mitigate this evil; but these are either costly to apply or involve increased consumption of battery. Such sparking may be prevented by the employment of the device represented in Figs. 1 and 2, comprising electrodes m' m^2 (preferably pieces of platinum) immersed in water (indicated at m) contained in a vessel m^3, such electrodes being supported in the stopper m^4 and connected by wires 8 and 9 with the circuit of the magnet d, one at each side of the magnet-coils. There is no perceptible evolution of gas, and it seems that either the extra current, which is the cause of sparking, discharges through the water, or else the arrangement acts as a storage-battery. The invention, so far as relates to this sparking-preventing device, is not limited to electric clocks, as the said device is equally applicable to other electrical apparatus in which it is desirable or necessary to prevent sparking at the point where the circuit is frequently broken and closed. The mercurial circuit-breaker shown in Fig. 6 as viewed from the left in Fig. 1 consists of a split tube i', secured to the pendulum-rod a' and inclosing a glass tube i, which is held by the split parts of said tube i', so that it can be turned somewhat stiffly on its axis, as shown by the arrow in Fig. 6. Two platinum wires i^2 i^3 are fused into said glass tube, which is partially filled with mercury to such a height that when the pendulum is near the end of its movement, to the right in Fig. 1, the mercury covers the ends of both the wires i^2 i^3, and thus electrically connects them; but when the pendulum has swung a certain distance to the left the uppermost of the wires i^2 will not be in the mercury and the circuit of the magnet and battery will be open. This form of contact is not novel, we believe; but by arranging the tube i' so that it can be rotated on its axis, as shown in Fig. 6, where the dotted circles show the position of the wires i^2 i^3 after the tube has been so rotated a certain distance, the time during which a circuit is closed can be easily varied, which is very easy and convenient in adjusting the clocks.

A form of doubly-adjustable mercurial circuit-controller is shown in Fig. 7, which may be used when two impulse-arms and two magnets are employed to actuate the pendulum. In said Fig. 7 the tube i rotates on its axis inside of the split tube i', while the split tube i' is secured to the pendulum-rod a' by a screw i^6, so that both tubes i and i' can be turned around said screw as an axis, as shown by dotted lines in Fig. 7, and the combination of the rotation of the tube i with the movement around the screw i^6 gives all necessary adjustments.

The open-circuit batteries used are liable to become polarized by constant use and may require rest from time to time, so that it is desirable to have two batteries, as shown, and alternate them, which is accomplished by the clock automatically, as shown in Figs. 1, 8, and 9, Fig. 8 being a detached view of the switch from the right of Fig. 1, portions of the ratchet-wheel h being broken away in Figs. 1 and 8 to show parts beneath.

For the sake of simplicity the switch is shown as actuated by the ratchet or seconds wheel; but in practice it is operated by one of the slowly-moving wheels of the train, as the ratchet-wheel would scarcely have sufficient power and would give too frequent alternations of the batteries.

In Fig. 1 lever k, pivoted at k' and in electrical connection with the frame of the clock, is arranged to be moved into connection with either of the contacts n n', as shown by dotted lines in Fig. 8, said movement being produced by a spring-arm k^3, secured to lever k and engaged by a pin h^2 in ratchet h. The spring k^3 is formed with a recess k^4, as shown in Fig. 9, and when the pin h^2 is in the position shown in Fig. 1 it forces said spring to the left or to the right in the reversed Fig. 8 until said pin arrives at the recess k^4, when it ceases to engage the spring; but when the pin h^2 reaches the upper end k^5 of the spring it will again engage with it and force the spring to the right in Fig. 1, and if the lever k were solely controlled by the spring k^3 and pin h^2 it would be slowly moved from n' to n and back again at each revolution of the wheel h. This slow motion is not desirable, for if switch k should leave n' before it made connection with n the circuit would remain permanently broken and the clock would stop, while if the switch is made to rest on both contacts at once, thus coupling up both batteries in parallel, we find by experience that the weaker battery acts as a shunt or branch circuit for the stronger and frequently diverts so much current as to stop the clock. To prevent these faults, two pins h^3 h^4, secured in the wheel h, project on the opposite side of said wheel from pin h^2, and a thin blade k^2, Figs. 1 and 9, projects from the free end of lever k in such manner that with said lever in the position shown in full lines in Fig. 8 pins h^3 h^4 revolve between said blade and the axis h' of wheel h; but with the lever in the position

shown in dotted lines in said figure said blade is between said pins and said axis. With the lever k in the position shown in full lines in Fig. 8, resting on contact n', thus rendering battery B operative and cutting out battery B′, if pin h^2 engage spring k^3 and force it into the position shown in dotted lines in said figure, pin h^3, engaging said blade k^2, will prevent lever k from moving with the said spring until pin h^3 has passed beyond said blade, and as at this time spring k^3 has become somewhat strained the lever k will snap over instantly into the dotted position and rest on contact n', thus cutting out battery B and cutting in battery B′. When pin h^3 engages the upper end k^5 of spring k^3 the above-described series of changes will be repeated in the reverse order, pin h^4 now engaging blade k^2 on the opposite side.

Although we have shown the clock as having one impulse-arm to actuate the pendulum, two can easily be applied, and we have built clocks in this way; but one impulse-arm acts as well as two.

We claim—

1. The combination of the pendulum with an impelling device and a detent for said impelling device, comprising a movable member mounted on said impelling device and movable therewith, and a stationary member, said movable member having an engaging portion in the path of movement of the pendulum-rod and operated thereby to disengage the detent members, the movable detent member thereby transmitting the pressure from the impelling device to the pendulum-rod, substantially as described.

2. The combination of the pendulum with an impelling device and a detent for said impelling device, comprising a movable member mounted on said impelling device and movable therewith, and a stationary member, said movable member having an engaging portion in the path of the pendulum-rod, which operates to disengage the detent while the latter transmits the pressure from the impelling device to the pendulum-rod, and an electro-magnet and armature that engage said impelling device and restore the same to the position in which it is held by the detent, substantially as described.

3. The pendulum and impelling device therefor, combined with an electro-magnet and armature and circuit for said magnet, controlled by said pendulum, engaging members by which the armature and impelling device are engaged when said armature is operated to restore the said impelling device to normal position, one of said members being elastic, whereby the impelling device is operated without shock, substantially as described.

4. The pendulum and impelling device and an electro-magnet and armature for restoring said impelling device, and circuit for said magnet, controlled by said pendulum, combined with a pair of electrodes or conductors connected with said circuit, one at one side and the other at the other side of the coils of said magnet, said electrodes being immersed in a fluid of high resistance, substantially as and for the purpose described.

5. The combination of a pendulum and impelling device therefor with an electro-magnet and armature for restoring said impelling device, two batteries connected with the said magnet, and a switch provided with an actuating-spring and a stop, and a movable portion of the clock co-operating with a portion of the said spring and stop, whereby the spring is strained with a tendency to shift the switch-arm, and the latter subsequently disengaged by its stop and thrown suddenly by said spring, substantially as and for the purpose described.

6. The combination of a pendulum and impelling device and restoring electro-magnet and armature for the latter, with a circuit-closer in circuit with the said magnet, comprising a tube containing a conducting-liquid supported on the pendulum-rod and operated thereby, circuit-terminals passing into the said tube, and a clamp for connecting the said tube with said pendulum, in which said tube may be rotated for the purpose of adjusting the position of the circuit-terminals with relation to the liquid therein, substantially as described.

7. The combination of the pendulum of an electric clock with an adjustable mercurial circuit-closer supported on said pendulum-rod, comprising a tube containing mercury, and contact-wires extending from the outside to the inside of said tube, and a socket in which said tube is held and is adjustable by rotation about the axis of the tube, said socket-piece being pivotally connected with the pendulum on an axis transverse to that of the tube, whereby the inclination of the tube may be adjusted, substantially as described.

8. A ratchet-toothed wheel h and electro-magnet and armature provided with a pawl co-operating with said ratchet-wheel to move the same step by step, and spaces corresponding to the length of the teeth, combined with the disk g, rigidly connected with the said ratchet-wheel and provided with a friction-surface, and the retaining-dog co operating with the said friction-surface, as described, to prevent backward movement of the ratchet when the pawl is moved back preparatory to advancing the ratchet another step, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WALTER K. MENNS.
WALTER J. DUDLEY.

Witnesses:
JOS. P. LIVERMORE,
M. E. HILL.