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(54) **ELECTRIC CLOCK**

(54) **HORLOGE ELECTRIQUE**

(57) **Abstract:**

V 250864 CANADA.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, CHARLES EDMOND PRINCE, of Stubbings Manor, Burchetts Green, Berkshire, England, Electrical Engineer, have invented certain new and useful "Improvements in Electric Clocks", of which the following is a specification:-

This invention relates to electrically driven clocks and the main idea of the invention is the mechanical separation of the pendulum or time-keeping element from the clockwork or indicating mechanism, so that the former vibrates substantially freely, such work as it has to perform being not only very small but also preferably of equal value at each swing of the time-keeping element. The time-keeping properties of the oscillating time-keeping element are thus entirely unaffected by lack of accuracy in the construction or adjustment of the indicating or clock mechanism, which can therefore be of a comparatively rough and cheap character without detriment to the accuracy of its indications.

The time indicating mechanism may be of any suitable known character the step by step movements of which are either effected or controlled by the operation of an electromagnetic device which is included in a circuit controlled by the swings of the pendulum and is momentarily closed at each swing by the engagement of a light yielding contact, and is automatically opened by an auxiliary device such as an electromagnetic circuit breaker, prior to the disengagement of the pendulum contact. The circuit arrangements are such that upon each swing of the pendulum a transient current traverses the circuit energising the relay or electromagnet which controls or actuates the indicating mechanism, and also traverses the energising coil or coils of the circuit breaker, which thereupon breaks the circuit andeffects other connections such that upoh the re-establishment of the current on the next swing of the pendulum this current traverses the energising coil or coils of the circuit breaker so as to reverse its polarity.

The impulses required to maintain the amplitude of the pendulum swings may be derived from the transient currents in the pendulum controlled circuit as by means of a solenoid or electromagnet traversed by such currents exerting a pull on a soft iron bar rigid with the pendulum or the swing of the pendulum may be sustained mechanically by energy stored in a spring or springs or in a weight through the agency of the time indicating mechanism or of an electromagnetic device, e.g. that operating or controlling the indicating mechanism, or any other suitable means may be adopted for automatically sustaining the pendulum vibrations, and such means may alternatively be operated by currents in a circuit established periodically by a contact or contacts upon or controlled by any suitable moving part of the time-indicating mechanism.

In the accompanying drawings Fig. 1 is a front elevation and Fig. 2 a side elevation, more or less diagrammatic, of an electrically driven clock illustrating ne arrangement for carrying the invention into practice; Fig. 3 is a diagram of the electric circuits; Figs. 4 and 5 are respectively a plan view and a sectional plan on an enlarged scale showing one construction of spring contact used in the control circuit; Figs. 6 - 10 inclusive are diagrammatic views in elevation and Figs. 6^a - 10^a inclusive are corresponding views showing the relation of the pendulum and the spring contacts of the control circuit for various phases of the swing of the pendulum; Fig. 11 is a diagram showing circuit arrangements for a master clock and groups of repeat clocks; and Fig. 12 is an elevation showing the preferred mechanism for actuating the step by step time indicators.

Referring to Fig. 3 the pendulum or timing element 1, which is pivoted at 2, carries a pair of contacts 3, 4, one on either side, which co-operate with contact springs 3', 4' connected respectively by leads 5 and 6 with coils 7, 8 of an electromagnetic circuit reverser and with the fixed contacts 9, 10 thereof. A light spring contact 11 carried by a polarised armature 12 is moved into flexed engagement with contact 9 or 10, according as the coil 7 or the coil 8 is energised. The spring contact 11 is connected with one terminal of a battery 13, the other terminal of which is connected through lead 14 with a time indicating device 15 and thence, through lead 16, with the pendulum suspension which in turn is electrically connected with the contacts 3 and 4.

Assuming the contact 11 of the circuit reverser to be in the position shown in flexed engagement with contact 9 and the pendulum 1 to be swinging from left to right, when contacts 3 and 3' engage a circuit will be established from battery 13 through spring contact 11, contact 9, energising coil 7, lead 5, contacts 3', 3, lead 16, time indicating device 15 and lead 14 back to battery. Consequent upon the current in coil 7 the armature 12 will be attracted towards the core of this coil and away from the core of coil 8, and the spring contact 11 will consequently break the circuit at contact 9 after a time lapse determined by the inertia of the armature and the degree of flexure of spring 11, and be thrown over against contact 10 to establish another circuit from battery 13, through contacts 11, 10, coil 8, lead 6, contacts 4', 4 (when, upon the return swing of the pendulum, these are brought into engagement), lead 16, time indicating device 15 and lead 14 back to battery.

It will be seen that the establishment of the control circuit by the pendulum, either through contacts 3,3' or 4,4', shifts the circuit breaker or reverser from one operative position to the other and the current which effects this also traverses the energising coil of the time-indicating mechanism, which may be of any suitable step-by-step electrically operated kind. Also, since upon each swing of the pendulum the contacts 3,3' (or 4,4') are in engagement during quite a large proportion of each swing, it follows that they will still be in contact at the moment that the circuit breaker or reverser is thrown over from one operative position to the other, and consequently the circuit is never broken at the pendulum or control contact, but always at the circuit reverser contact.

There is shown in dotted lines as included in the lead 5 a solenoid 17 which is traversed by the transient current which flows around the circuit when the contacts 3,3' are in engagement. This solenoid is designed to co-operate with an arm 17' shown in dotted lines as rigidly connected with the pendulum 1. This arm is of magnetic material or partly of magnetic material and is suitably arranged with respect to the solenoid 17 so as to come within its influence during part of the swing towards the right and thereby receive an impulse which maintains the amplitude of swing of the pendulum.

Any suitable magnetic means may be employed to prevent the action of the coil 17 producing an increasing amplitude of

..g, as for example by having only the outer end of the rod 17' of magnetic material or by so grading the cross section or magnetic permeability of the rod that as soon as the pendulum swings outwardly to the required extent the pull exerted by the coil 17 will be reversed. Coil 17 may be arranged to impart the sustaining impulse at the most effective moment, that is when the pendulum has maximum velocity, or it may be arranged to effect the impulse after that position has been passed, in which case a slightly greater energy is required, but this disposition of the coil tends to compensate automatically for decreasing or increasing amplitudes of swing.

While, however, any sustaining impulse required by the pendulum may be imparted electrically, either by means of the transient current in the controlling circuit as above described or by means of a current periodically applied at any other suitable time interval, it is preferred to make the sustaining impulse independent of the constancy of any source of electric current, and one method of achieving this is hereinafter described in detail with reference to Fig. 6 to Fig. 10[a].

In the clock illustrated in Figs. 1 and 2 corresponding parts are indicated by the same reference numerals as are used in Fig. 3. As shown in these Figs. the pendulum 1 is suspended by means of a strip 18 of steel or other suitable resilient material rigidly held by a clamp 19 between the jaws of which the strip 18 passes to an adjustment device such as a forked arm 20 upon which the spring strip 18 is supported and which is pivoted at one end to the frame and has an adjusting screw 21 whereby the strip, when it is unclamped, may be raised or lowered to any desired small extent with consequential alteration of the length of the pendulum when the strip is again secured between the jaws of the clamp 19.

A subsidiary adjustment of the effective length of the pendulum may be provided in the form of a small mass 22 ig.11) slidable on the pendulum rod which is suitably gradu-ated. This mass 22 may be in the form of a split spring sleeve or collar encircling the pendulum rod and provided with press studs 23 whereby the sleeve may be expanded and moved up or down without interfering with the swing of the pendulum.

While in some respects it is immaterial whether the pendulum contacts 3, 4 are rigid and the fixed contacts 3', 4' yielding or conversely, the former arrangement is preferred as it affords convenient means for applying mechanically to the pendulum a periodic sustaining impulse of constant value. A convenient form of yielding contact for the purposes contemplated is shown in Figs. 4 and 5, wherein 24 is a metal tube having one or more longitudinal slits at its inner end which fits friction tight over a boss 25 on a crank arm 26 fulcrumed on a terminal block suitably connected in the control circuit. Inside the tube 24 is a spring contact wire 27 preferably having a contact surface of a non-oxidising character, the outer or free end of which is exposed by a portion of the tube 24 being cut away as indicated at 24', while the inner fixed end is rigidly secured to the tube 24. The angular displacement of the contacts 27 from the central position of the pendulum can be adjusted by turning the crank arms 26 about their fulcrums by means of the crank handles 28, any suitable means being provided to secure the contacts in the positions to which they have been adjusted.

The contacts 3, 4 on the pendulum may consist of rigid platinum wires arranged substantially at right angles to the spring contact wires 27 of the fixed contacts 3', 4'. As the pendulum swings outwardly on either side from the central position the contact elements on that side engage and establish the circuit of coil 7 or coil 8 as the case may be. The spring 27 is flexed by the pendulum during the remainder of the outward swing and reacts on the pendulum during the corresponding part of the inward swing, the energy stored in the spring by its flexure being thus returned to the pendulum. By arranging that the tensioned spring 27 acts on the pendulum over a longer distance during the inward swing than that over which the pendulum acts upon the spring to energise it during the outward swing, more energy is imparted to the pendulum upon the inward swing than is absorbed from the pendulum upon the outward swing, and it is thus possible by means of this residium of energy to compensate the resisting forces opposing the movement of the pendulum and thereby maintain the amplitude of its swing. With this object the spring contact 27 is displaced so as to be partly tensioned or energised, after the pendulum on its inward swing has moved away from it, by means of a movable member, for example a pin 29, (Figs.6-10[a]), attached to the armature of an electromagnetic device included in a circuit established by the operation of the contacts 3,3' or 4,4'. As shown in Figs. 1 and 2 this electromagnetic device is the same device as that which operates to break the energising circuit. The changes in position of the co-operating parts are illustrated in Figs. 6-10[a]. In Figs. 6 and 6[a] the pendulum 1 is shown in the intermediate position moving from right to left and the pin 29 in its inoperative position in so far as regards the flexure of spring contact 27. In Figs. 7 and 7[a] the pendulum has moved over to establish contact between the contact elements 4 and 4', thereby energising electromagnet 8 and shifting the armature 12 from one operative position to the other. This movement of the armature, with which pin 29 is rigidly connected, brings the latter into engagement with the spring contact 27, displacing the latter outwardly to a definite extent which can be adjusted by appropriate means.

The pendulum, on its return swing towards the right, first establishes contact with the spring 27 in its displaced position, as shown in Figs. 3 and 8[a], thereby again energising one or other of the electromagnets 7 and 8 and consequently shifting the armature 12 back into its other operative position, so that the pin 29 is withdrawn into its inoperative position, as shown in Figs. 9 and 9^{a}. The pendulum continues its outward movement to the right, still further flexing the spring 27, until it reaches its limiting position as shown in Figs. 9 and 9^{a}, in which position the displacement of the spring 27 is a maximum. On the return/inward swing of the pendulum the spring follows up the pendulum over the complete range of its flexure, since the pin 29 has been retracted and is no longer in a position in which it can arrest the return of the spring 27 to its initial position, as shown in Figs. 10 and 10^{a} and 6 and 6^{a}. It will be seen therefore that during the return or inward swing of the pendulum the tension spring 27 acts through an additional range upon the pendulum as compared with the range of engagement on the outward swing, namely over the distance indicated by the difference in the position of the spring 27 as shown in Figs. 7 and 7^{a} and 8, 8^{a}, and its position as shown in Figs. 6 and 6^{a}.

Alternatively the sustaining impulses may be communicated to the time-keeping element by means of a light spring on the movable element of the electromagnetic device operating or controlling the time-indicating mechanism, which spring when the movable element shifts from one operative position to another is brought into contact with the time-keeping element and gives it the required sustaining impulse.

By such a method of sustaining the oscillations of the time-keeping element the amplitude and time-keeping are entirely independent of variations, from whatever cause, in the electric energising circuit. Further, the amplitude of swing can be readily adjusted by altering one or both of the limiting positions of the spring acting upon the time-keeping element.

As already indicated, the sustaining impulse may be applied by means of a gravity device energised in the manner above described by means of transient currents brought into action by the time-keeping mechanism or by a suitable electromagnetic apparatus. Further, instead of applying a sustaining impulse to the time-keeping element at every alternate vibration thereof, the requisite impulse may be applied at every vibration or at any desired intervals.

While any suitable electromagnetic device such as, for example, the circuit breaker 7, 8 itself, may be used for applying a step-by-step movement to the time indicator 15, it is preferred to use an arrangement such as shown in Fig. 12, where in an electromagnet 30 is energised momentarily upon each swing of the pendulum when the energising circuit is established by engagement of the contacts 3, 3' or 4, 4' respectively, and upon being so energised attracts an armature 31 against the reaction of a spring 32. This armature, or an extension thereof, carries a projecting pin 33 which is adapted to engage alternately with the teeth of two wheels 34, 35 in mesh with each other, one of these wheels, say 34 being a member of the train of wheels which drive the clock hands. The pin or pallet 33 is suitably cam-formed on its working face, so that when for example the armature 31 is attracted by the magnet 30, this operating cam face engages a tooth of the wheel 35 and shifts the latter in the direction shown by the arrow through an angle corresponding with half the pitch of its teeth. The wheel 34 being permanently in mesh with 35 will similarly be shifted through half a tooth. Upon the return of the armature by the spring 32 the pallet 33 engages the next tooth of the wheel 34, shifting it through an angle represented by half the pitch of its teeth, and consequently also shifting wheel 35 correspondingly. Thus, for each double oscillation of the armature the wheel 34 will be moved through an angle equal to the pitch of its teeth. With a suitably shaped pin or pallet 33, e.g. one which is cylindrical on its driving face and flat on its rear face, in appropriate relation with the teeth of the two meshing wheels an unfailing forward movement of the wheels in accordance with the oscillations of the armature or the like is assured and any possibility of backward movement of the wheels by reason of vibration or any other cause is prevented.

The relation of pallet to teeth may be adjusted by mounting the pallet on the armature or the like, so that it can be shifted longitudinally or the armature itself may be capable of being adjusted longitudinally but the preferred method is to journal one of the two meshing wheels in a bracket, indicated in dot and dash lines at 35' in Fig. 12, which can be swung about the axis of the other wheel and secured in any desired position. As one of the objects of this part of the invention is to obtain an absolutely dependable conversion of oscillating into rotational movement using rough apparatus, e.g. stamped wheels the meshing teeth of which may have considerable back lash, such an adjustment is necessary to enable the pallet and teeth to be brought in such relation as to ensure the desired step-by-step forward movement and provide an absolute lock against backward movement. One or both of the gear wheels may also be subject to the action of a spring brake 36 or equivalent steadying device.

For operating a time-indicating mechanism or group of such mechanisms other than that designated by 15, there may be included in the energising circuit of the mechanism 15 an electromagnetic relay 37 (Fig.11) which, at each swing of the pendulum is momentarily energised and operates by means of a suitably arranged switch 38 to close a circuit including a local battery 39 which supplies the momentary actuating currents for a group of time-indicating mechanisms 40 of the same step-by-step character as the mechanism 15, the individual members of the group being connected in parallel with each other across the terminals of the battery 39. Instead of operating the subsidiary time indicating mechanisms at each swing of the pendulum, they may be arranged to be actuated in the same step-by-step fashion at other time intervals. For example, they may be actuated every half minute by an arrangement such as illustrated in another part of Fig. 11 through the medium of a contact pin 41 upon a disc 42 secured on the minute arbor of the clock train of the mechanism 15. This pin twice every minute makes contact with one or other of two spring contacts 43, 44 which are connected respectively with the coils 7', 8' of an electromagnetic circuit-breaking mechanism which is in every respect identical with the mechanism illustrated diagrammatically in Fig. 3. The circuit arrangements for this device are clearly shown in Fig. 11 and the device controls the operation of an electromagnetic relay 37' which, through the agency of an armature a ctuated swithh 38', closes once every half minute a circuit which includes a local battery 39' by which current is supplied to actuate a group of step-by-step time-indicating mechanisms 40'.

When the pin 41 encounters the spring contact 43 a circuit is established from battery 13 through a brush contact 45, disc 42, pin 41, spring contact 43, coil 7', contact pin 9', contact spring 11', relay 37' back to battery 13. Consequently, with contact established between pin 41 and contact spring 43 a momentary current will traverse coil 7' as soon as the energising circuit is completed and the armature 12' and with it the contact spring 11', will be thrown over to the other operative position, thereby breaking the circuit of the relay 37' at the contacts 9', 11'. This magnet cannot therefore be again energised during the remainder of the period of contact between pin 41 and contact spring 43, but when pin 41 moves round into contact with spring 44 a circuit will be established from battery 13 through coil 8' and a momentary current will traverse the coil 8' and also the relay 37' and the armature 12' will immediately be thrown over into its other operative position. Thus, once for every half minute there will be a momentary current through relay 37' actuating the switch 38' and bringing the local circuit into operation to move the time-indicating mechanisms 40' through one step.

Provision is made for setting the timing mechanism 15, or other timing mechanisms associated therewith, by short circuiting the mechanism 15 as indicated by the dot and dash lines 46 in Figs. 3 and 11, a suitably placed key being provided for this purpose. With the mechanism so short circuited the pendulum and the circuit reverser will continue to operate without affecting the clock or indicating mechanism 15, which will remain stationary until the short circuit is removed. This provides means for re-setting a clock which is in advance of the true time. To set a clock forward to the true time the pendulum contacts are short circuited to the pendulum by means of a suitable switch, whereby the leads 5, 6 are directly connected with each other as through the connections indicated by dot and dash lines 47, 48 in Figs. 3 and 11. With this switch closed the circuit breaker 7, 8 is actuated rapidly independently of the pendulum and consequently the clock mechanism 15 is advanced rapidly until, when the true time is reached, the circuit through leads 47, 48 is then broken and the clock resumes normal working.

It will be obvious that the apparatus hereinbefore described may be modified in many respects without departing from the invention, and the various elements of the essential part of the apparatus herein described are given by way of example only. The essential feature of the invention is the entire mechanical separation of the pendulum or equivalent time-keeping element from the time-indicating mechanism, so that the pendulum oscillates as a free pendulum and is not called upon to do nay work whatever either in connection with the operation of the time-indicating mechanism or of any machanism required for sustaining the amplitude of the vibrations of the time-keeping elements.

What I claim as my inevntion is:-

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1. In an electrically driven clock, a time-indicating mechanism and an oscillating time-keeping element of which the oscillations are substantially free from the time-indicating mechanism, an electromagnetic device controlling the operation of the time-indicating mechanism, a pair of make-and-break devices in the electric circuit to said electromagnetic device aletrnately opened and closed by the oscillating movement of the time-keeping element, and an auxiliary device for breaking said circuit.

2. An electrically driven clock according to claim 1, wherein the auxiliary device for breaking the circuit to the electromagnetic device comprises a polarised element and a nonpolarised element, the latter of which is energised by the current in the circuit controlled by the time-keeping element.

3. An electrically driven clock according to claim 1, wherein the auxiliary device for breaking the circuit of the electromagnetic device comprises a non-polarised element in said circuit and a polarised element one of which elements is movable, said moveble element adapted, when the non-polarised element is energised by the closing of one or the other of said make-and-break devices, to change its position to first break the energising circuit to the electromagnetic device and then to establish connection to the other make and break device, whereby on the next oscillation of the time-keeping element the circuit thereby closed to said non-polarised element reverses the polarity of the latter.

4. An electrically driven clock according to claim 1, wherein means are provided for rendering the time-indicating mechanism inoperative while the time-keeping element continues to function.

5. An electrically driven clock according to claim 1, wherein means are provided for electrically operating the time-indicating mechanism independently of the time-keeping

element.

6. An electrically driven clock according to claim 1, wherein the time-indicating mechanism is operated by the current in a local controlled by the time-keeping element.

7. In an electrically driven clock according to claim 1, means for imparting periodic sustaining impulses to the time-keeping element by means of currents in the circuit established by the time-keeping element.

8. In an electrically driven clock according to claim 1, means for imparting sustaining impulses to the time-keeping element by means of currents in the circuit established by the time-keeping element, the frequency of which sustaining impulses is controlled by the time-indicating mechanism.

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9. An electrically driven clock according to claim 1, wherein the time-keeping element is a pendulum and the make-and-break devices comprise two fixed contacts one on either side of the pendulum, and a pair of contacts carried by said pendulum and cooperating with said fixed contacts respectively, one of each cooperating pair of contacts being of the character of a light spring.

10. An electrically driven clock according to claim 1, wherein the time-keeping element comprises a pendulum and the make-and-break devices comprise a pair of contacts, one on each side of the pendulum, and a second pair of contacts carried by said pendulum and cooperating, respectively, with said first-named contacts, one contact of each cooperating pair being adjustable in position for varying the moment of contact with its cooperating element.

11. An electrically driven clock according to claim 1, wherein the time-keeping element comprises a pendulum and the pair of make-and-break devices are located, respectively, on opposite sides of said pendulum each of said make-and-break devices comprising a normally fixed contact and a contact car-

ried by said pendulum, a pair of crank levers adjustable in position by rotation about their fulcrums and each carrying one of said fixed contacts, and means for clamping said crank levers in adjusted position.

12. An electrically driven clock according to claim 1, wherein the time-keeping element comprises a pendulum and the pair of make-and-break devices each comprises a contact carried by said pendulum and a contact with which said first-named contact cooperates, said last-named contacts each being mounted to swing in an arc for adjustment towards and away from said pendulum.

13. An electrically driven clock according to claim 1, wherein the auxiliary device for breaking the circuit to the electromagnetic device comprises a movable magnetic element, a spring contact carried by said movable element, and a pair of adjustable but normally fixed contacts with which said spring contact cooperates.

14. An electrically driven clock comprising a time-indicating mechanism, an oscillating time-keeping element mechanically separate from the time-indicating mechanism, an electromagnetic device included in a circuit controlled by the time-keeping element, a mechanical device energised by the operation of the said electromagnetic device and means whereby periodic sustaining impulses are imparted by the said energised mechanical device to the time-keeping element.

15. An electrically driven clock comprising a time-indicating mechanism, an oscillating time-keeping element mechanically separate from the time-indicating mechanism, an electromagnetic device controlling the operation of the time-indicating mechanism, a mechanical device adapted to impart periodic sustaining impulses to the time-keeping element, said mechanical device being energised by the operation of the electromagnetic device which controls the operation of the time indicating mechanism.

16. An electrically driven clock comprising a time -

indicating mechanism, an oscillating time-keeping element mechanically separate from the time-indicating mechanism, an electromagnetic device included in a circuit controlled by the time-keeping element, and a spring energised by the operation of the said electromagnetic device and operating by its reaction to impart periodic sustaining impulses directly to the oscillating time-keeping element.

17. An electrically driven clock comprising a time-indicating mechanism, an oscillating time-keeping element mechanically separate from the time-indicating mechanism, an electromagnetic device controlling the operation of the time-indicating mechanism, a pair of spring contact devices in the electric circuit to the said electromagnetic device alternately opened and closed by the oscillating movement of the time-keeping element, means operated by the said electromagnetic device for energising the spring of one of said contacts and means whereby the reaction of the said energised spring is imparted directly to the time-keeping element.

18. An electrically driven clock according to claim 1, wherein the time-indicating mechanism comprises an electromagnetically operated oscillating element, a pair of toothed wheels permanently in mesh with each other, and a pallet carried by the oscillating element and cooperating alternately with the teeth of the said wheels to rotate the latter through a definite angle at each swing of the oscillating element.

19. An electrically driven clock according to claim 1, wherein the time-indicating mechanism comprises an electromagnetically operated oscillating element, a pair of toothed wheels permanently in mesh with each other, and a pallet carried by the oscillating element and cooperating alternately with the teeth of said wheels, said pallet consisting of a pin of substantially cylindrical shape upon its operating face and of flat shape on the reverse face.

20. An electrically driven clock according to claim 1,

wherein the time-indicating mechanism comprises an electro-magnetically operated oscillating element, a pair of toothed wheels permanently im mesh with each other, a pallet carried by the oscillating element and cooperating alternately with the teeth of the said wheels to rotate the latter through a definite angle at each swing of the oscillating element, and means for adjusting the relation of the pallet with respect to the teeth of the said wheels.

21. An electrically driven clock according to claim 1, wherein the time-indicating mechanism comprises an electro-magnetically operated oscillating element, a pair of toothed wheels permenently in mesh with each other, one of said wheels being journalled in a bracket mounted to swing about the axis of the other wheel, and a pallet carried by the oscillating element and cooperating alternately with the teeth of the said wheels to rotate the latter through a definite angle at each swing of the oscillating element.

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Fig.1.

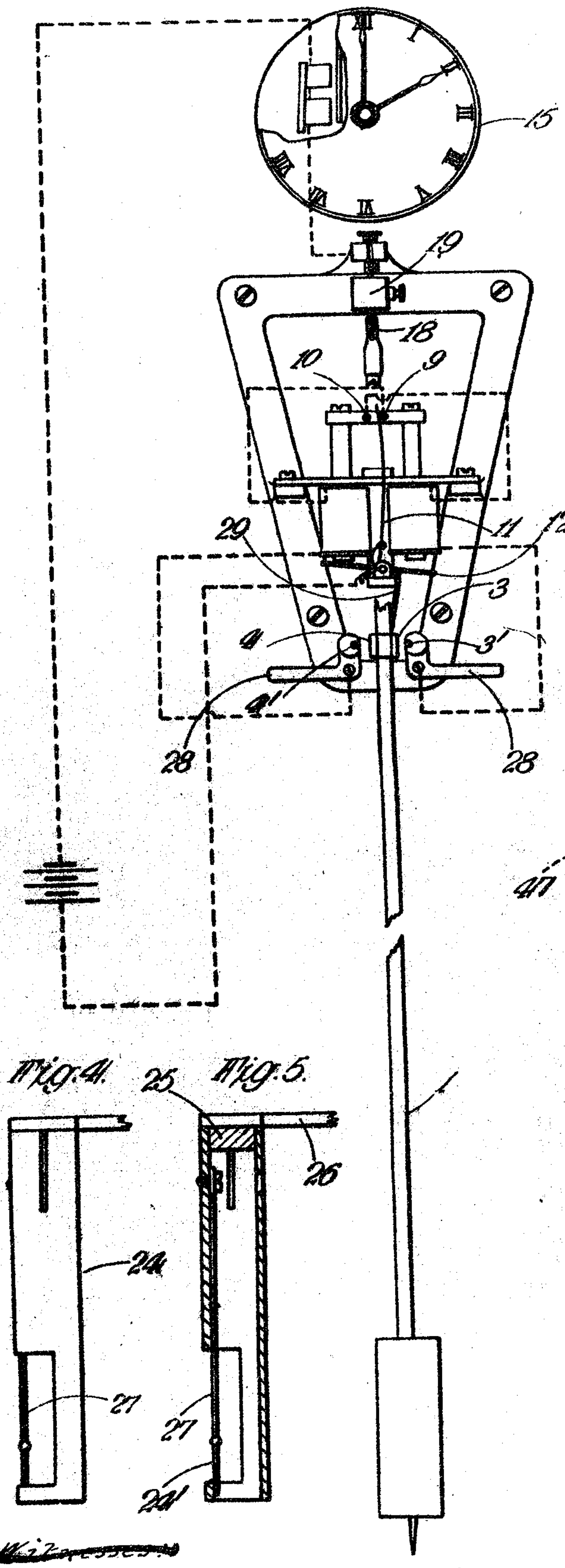


Fig.4. Fig.5.

Fig.2.

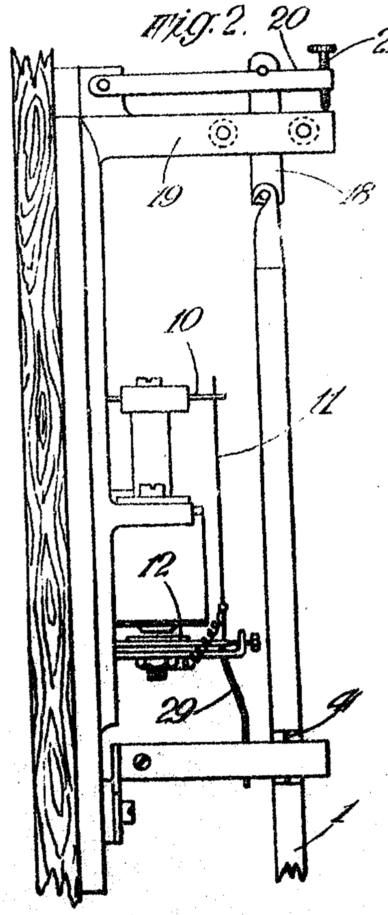
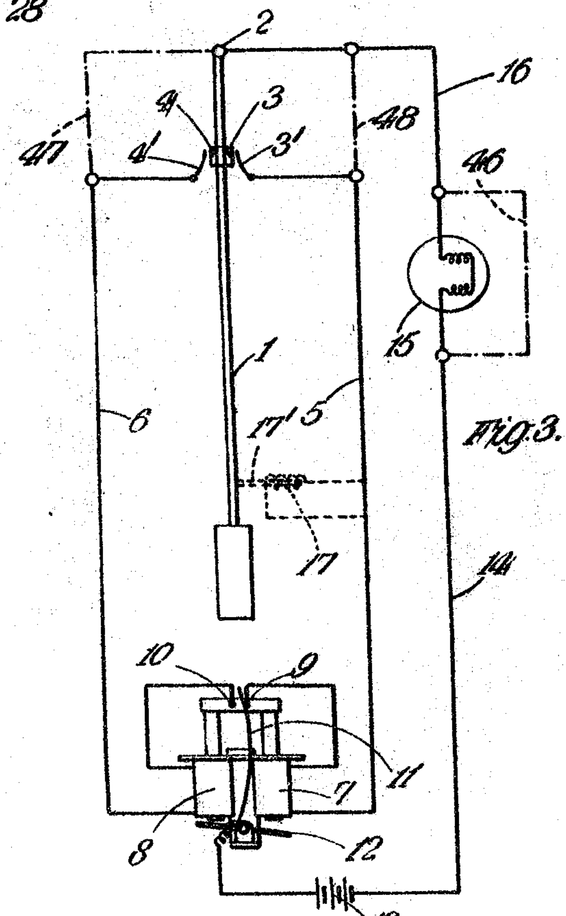


Fig.3.



~~Witnesses:~~

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Montreal, this 30 day of October 1923
Charles Edmond Prince
By his Attorney.

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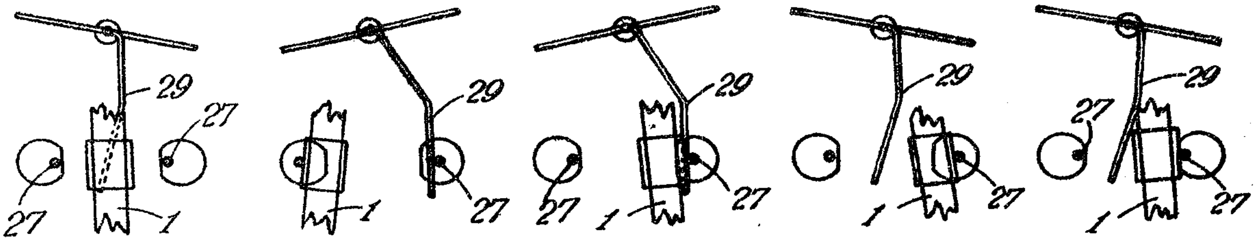
Fig. 6. Fig. 7. Fig. 8. Fig. 9. Fig. 10.



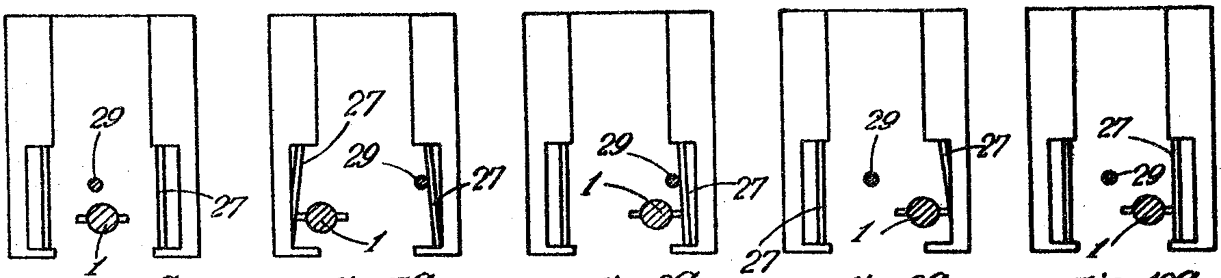


Fig. 6.a Fig. 7.a Fig. 8.a Fig. 9.a Fig. 10.a

Fig. 12.

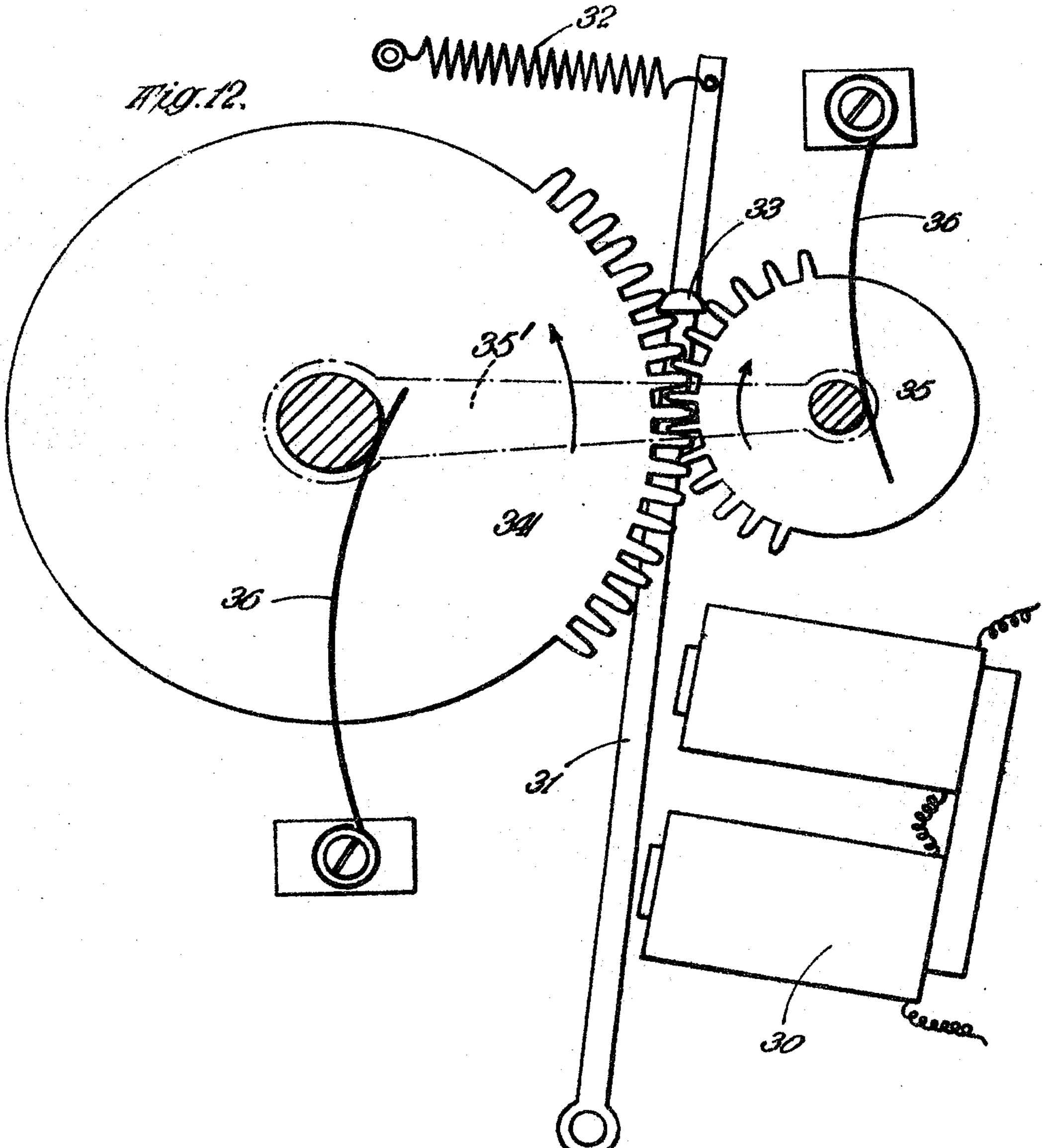


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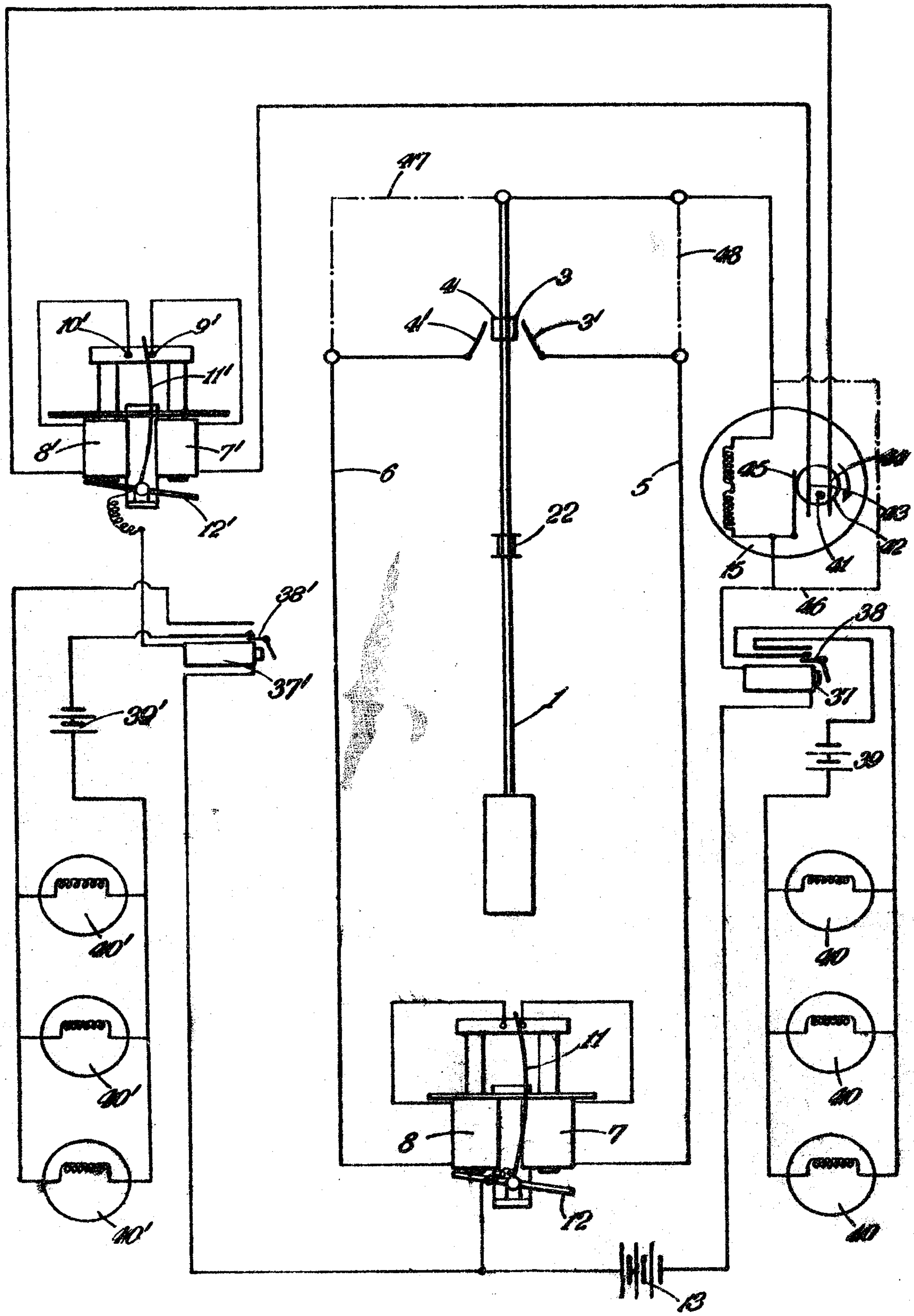
Fig. 11.



Witnesses:

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Montreal this 30 day of October 1923
Charles Edmond Prince
By his Attorney [signature]