PATENT SPECIFICATION

221,626

Application Date: Aug. 10, 1923. No. 20,398/23.

(Patent of Addition to No. 206,186: June 1, 1922.)

Complete Left: April 16, 1924.

Complete Accepted: Sept. 18, 1924.

PROVISIONAL SPECIFICATION.

Improvements in Electric Clocks.

I, CHARLES EDMOND PRINCE, a British subject, of Stubbings Manor, Burchetts Green, Berkshire, do hereby declare the nature of this invention to be as follows:—

In the Specification No. 206,186 I have described an electrically driven clock wherein, by the mechanical separation of the time-keeping element from the time-indicating mechanism, the oscillations of the former are substantially free. In the apparatus therein described periodic sustaining impulses are imparted to the time-keeping element by means of currents in an electric circuit established by the time-keeping element.

The present invention consists in certain improvements in or modifications of the invention claimed in the aforesaid specification. According to this invention, instead of deriving the periodic sustaining impulses from electric currents in a circuit established by the time-keeping element, the swing of the latter is sustained mechanically by energy stored in a spring or springs or a weight through the agency of the time-indicating mechanism or an electromagnetic device, *e.g.* that operating or controlling the indicating mechanism.

For example, if the range of movement of a light spring (which may be one of the spring contacts controlling the energising circuit of the electromagnetic device operating the time-indicating mechanism) energised by the time-keeping element at alternate vibrations is changed at the appropriate time so that the tensioned spring acts upon the time-keeping element over a longer distance during the return swing of this element towards the central or neutral position than that over which the time-keeping element acts upon it to energise it during its outward swing, a residuum of energy is imparted to the time-keeping element upon its inward swing towards the neutral position and the amplitude of the swings thereby sustained. Thus the spring may be displaced so as to be partly tensioned or energised, after the time-keeping element on its inward swing has moved away from it, by means of a movable member of the aforesaid electromagnetic device which, upon the return of the time-keeping element on its outward swing into contact with the spring, is withdrawn consequent upon the closure or opening of the energising circuit of the electromagnetic device so as to leave the energised spring free to follow up the movement of the time-keeping element on its return swing towards the central or neutral position.

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 this 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 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 vibration or every alternate vibration thereof, the requisite impulse may be applied at any desired intervals.

Dated this 10th day of August, 1923.

ABEL & IMRAY,
Agents for the Applicant,
30, Southampton Buildings, London,
W.C. 2.

COMPLETE SPECIFICATION.

Improvements in Electric Clocks.

I, CHARLES EDMOND PRINCE, a British subject, of Stubbings Manor, Burchetts Green, Berkshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In the Specification filed with my Patent Application No. 206,186 I have described an electrically driven clock wherein, by the mechanical separation of the time-keeping element from the time-indicating mechanism, the oscillations of the former are substantially free. In the apparatus therein described periodic sustaining impulses are imparted to the time-keeping element by means of currents in an electric circuit established by the time-keeping element.

The present invention consists in certain improvements in or modifications of the invention claimed in the aforesaid specification. According to this invention, instead of deriving the periodic sustaining impulses from electric currents in a circuit established by the time-keeping element, the swing of the latter is sustained mechanically by energy stored in a spring or springs or equivalent weight through the agency of a movable element of the electromagnetic circuit breaker, which latter controls the operation of the time-indicating mechanism and said movable element, consequent on the movement of the time-keeping element from one operative position to another, engages a spring or weight and energises the latter to impart a sustaining impulse to the time-keeping element, or the movable element of the circuit breaker may be provided with a light spring or the like which is brought into contact with the time-keeping element and imparts to it the required sustaining impulse.

The invention is illustrated in the accompanying drawings, Fig. 1 is a diagrammatic representation of the circuit arrangement of an electric clock operating as described in the afore-mentioned patent specification; Figs. 2 and 3 are respectively a plan view and a sectional plan showing on an enlarged scale one construction of spring contact used in the control circuit of the clock; Figs. 4—8 inclusive are diagrammatic views in elevation; and Figs. 4^a—8^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.

Referring to Fig. 1 the pendulum or timing element 1, which is pivoted at 2, carries a pair of contacts 3, 4, one on either side, which cooperate with contact springs 3^1, 4^1, 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 3^1 engage a circuit will be established from battery 13 through spring contact 11, contact 9, energising coil 7, lead 5, contacts 3^1, 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 4^1, 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, 3^1, or 4, 4^1, 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, 3^1 (or 4, 4^1) 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.

While in some respects it is immaterial whether the pendulum contacts 3, 4 are rigid and the fixed contacts 3^1, 4^1 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. 2 and 3, 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 fulcrummed 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 24^1, 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 crank handles (not shewn, 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 3^1, 4^1. 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 spring, and it is thus possible by means of this residuum 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. 4—8^a), attached to the armature of an electromagnetic device included in a circuit established by the operation of the contacts 3, 3^1 or 4, 4^1. This electromagnetic device may conveniently be the same device as that which operates to break the energising circuit. The changes in position of the cooperating parts are illustrated in Figs. 4—8^a. In Figs. 4 and 4^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. 5 and 5^a the pendulum has moved over to establish contact between the contact elements 4 and 4^1, 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. 6 and 6^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. 7 and 7^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. 7 and 7^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. 8 and 8^a and 6 and 6^a. It will be seen therefore that during the return or inward spring 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 spring, namely over the distance indicated by the difference in the position of the spring 27 as shown in Figs. 5, 5^a and 6, 6^a, and its position as shown in Figs. 4 and 4^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 electro-magnetic 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.

The pendulum may be relieved of the duty of actually establishing the circuit of the electromagnetic device on its reverse swing by omitting pendulum contact 4 altogether and substituting for contact 4^1 (Fig. 1), which cooperates with pendulum contact 4, another contact which with suitable changes in the circuit connections cooperates with spring contact 3^1 to establish the energising circuit of magnet coil 8 when the pendulum on its inward swing towards the left leaves the spring contact 3. For example, instead of the part indicated at 4^0 in Fig. 3 being merely a positioning stop determining the limit of movement of the spring 27 towards the left, it may be an insulated contact stud which cooperates with spring contact 27 to complete the circuit of coil 8 the instant the pendulum disengages spring 27.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An electrically driven clock of the kind claimed in Patent Specification No. 206,186, wherein periodic sustaining impulses are imparted mechanically to the time-keeping element through the agency of a movable element of the electromagnetic circuit breaker which controls the operation of the time-indicating mechanism, said movable element, consequent on the movement of the time-keeping element from one operative position to another, engaging with a spring or weight and energising the latter to impart to the time-keeping element a sustaining impulse.

2. An alternative arrangement according to Claim 1, wherein a sustaining impulse is imparted to the time-keeping element by the contact of a light spring on the movable element of the circuit breaker with the time-keeping element.

3. An electrically driven clock according to Claim 1, wherein the time-keeping element contacts with a spring upon each side thereof and by closing an electric circuit shifts the circuit breaker from one operative position to another and consequent upon the contact of the time-keeping element with one spring or weight the movable element of the circuit breaker moves over to the other spring or weight and displaces the latter so that upon the return inward swing of the time-keeping element the spring or weight acts through an additional range upon the time-keeping element as compared with the range of engagement on the outward swing.

4. An electrically driven clock according to any of the preceding claims, wherein the amplitude of swing of the time-keeping element can be adjusted by altering one or both of the limiting positions of the energised spring or weight.

5. An electrically driven clock according to the preceding claims, wherein periodic sustaining impulses are imparted to the time-keeping element substantially in the manner herein described with reference to the accompanying drawings.

Dated this 16th day of April, 1924.

ABEL & IMRAY,
Agents for the Applicant,
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W.C. 2.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1924.

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1

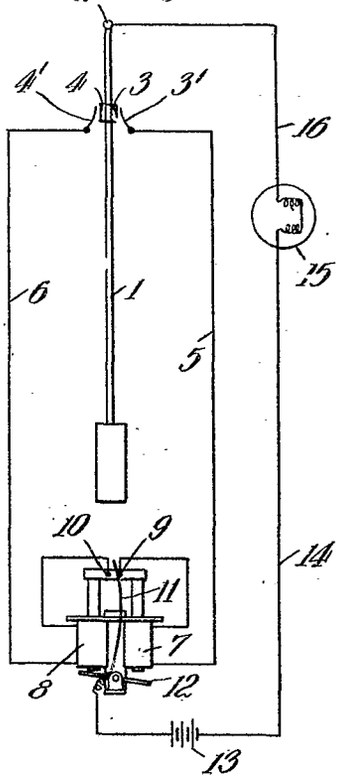


Fig. 2

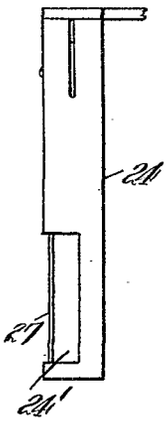


Fig. 3

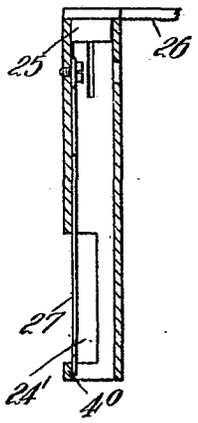


Fig. 4

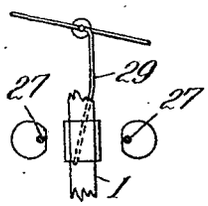


Fig. 5.

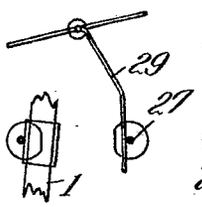


Fig. 6

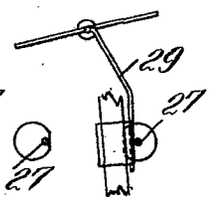


Fig. 7

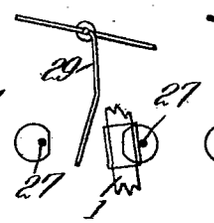
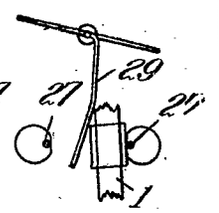


Fig. 8.



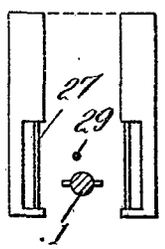


Fig. 4a

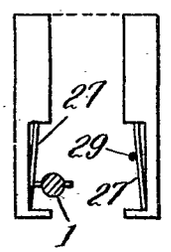


Fig. 5a

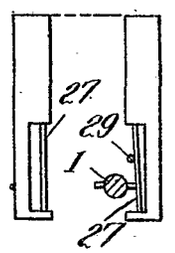


Fig. 6a

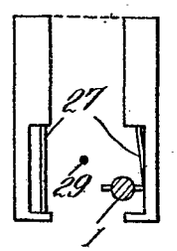


Fig. 7a

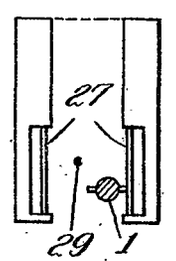


Fig. 8a

Malby & Sons, Photo-Litho