N° 14,873 A.D. 1909

Date of Application, 26th June, 1909

Complete Specification Left, 24th Dec., 1909—Accepted, 23rd June, 1910

PROVISIONAL SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, FRANK HOLDEN, of 1, Harcourt Buildings, Temple, London, W.C., Electrical Engineer, do hereby declare the nature of this invention to be as follows:—

My invention relates to electric clocks and has for its object to provide an improved construction in which the sparking at the contacts when the balance-wheel or pendulum is energised is reduced to a minimum or entirely obviated.

My invention consists in energising the pendulum or balance wheel by making and breaking automatically the current in a coil which has relative movement with regard to a magnetic field, the arrangement preferably being such that the pendulum or balance-wheel receives its impulse when it has the highest velocity, that is, at the middle of its swing or oscillation, so that due to the large counter-electromotive force developed in the coil a highly efficient electromotive device is obtained and sparking at the contacts is reduced to a minimum. My invention further comprises an improved form of contact device in which the pendulum or balance-wheel carries a pivoted pin which hangs by gravity in a vertical position and which wipes over a fixed contact for energising the coil during a small portion of the swing or oscillation of the pendulum or balance-wheel.

In carrying my invention into effect, as applied for example to a pendulum clock, the pendulum is fitted at its lower end with a coil the self-induction of which is made as small as possible. This coil is adapted to swing in the field between the limbs of a permanent magnet, and the electromagnetic damping, resisting its motion in the magnetic field, is rendered as small as possible, for example by avoiding the use of a closed metal former for supporting the turns of the coil. On the side of the pendulum a light piece of flexible metal or a pin pivoted about a horizontal axis is fitted, this metal piece or pin being adapted to wipe over a pair of horizontally arranged metal pins. The metal piece or pivoted pin is insulated and connected to one end of the pendulum coil while the other end of the coil is connected to an intermediate point in a battery of cells. The horizontally arranged contact pins are also insulated and are connected respectively to the terminals of the battery. The pivoted pin may have a slotted pivotal mounting so that it is capable of a small amount of movement along its length.

The fixed contact pins are so placed with regard to the magnet that the vertical pivoted contact will engage with one or the other according to the direction of swing of the pendulum when the pendulum is at or about the middle of its swing. In this position the coil is energised and the pendulum receives its impulse, one impulse being given on each swing. Instead of a pair of horizontally arranged contacts and two batteries being used a single half-insulated horizontal contact and a single battery may be provided so that the circuit of the battery through the coil will only be closed by the pivoted contact once in a double swing.

The pendulum is arranged to actuate the clock train in any suitable manner, as for example, by operation of a pawl on a toothed ratchet-wheel geared to the clock train.

[*Price 8d.*]

It will be obvious that instead of arranging the coil on the pendulum this coil might be fixed and the magnet carried by the pendulum and further instead of using a pendulum a balance-wheel might be fitted with the coil or magnet and also that instead of a permanent magnet an electro-magnet excited from the battery or other source may be used.

Dated this 25th day of June, 1909.

JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, FRANK HOLDEN, of 1, Harcourt Buildings, Temple, London, W.C., Electrical Engineer, 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:—

My invention relates to improvements in an already known type of electric clock in which the current in a coil interacts with a magnetic field, the current being automatically made and broken to produce the oscillations of the pendulum which either carries the magnet or the coil.

In some clocks of this type hitherto proposed, the coil which swings with the pendulum surrounds and moves along a straight or curved magnet; that is to say, one in which the magnetic circuit is largely through air, and movable contacts have been provided adapted to remain in engagement with contacts on the pendulum over a considerable portion of the swing of the pendulum in each direction so that the coil is supplied with current for a considerable portion of each oscillation. In other forms of such clocks, a similar arrangement has been employed except that the coils have been fixed and the straight magnet attached to the pendulum. One disadvantage of such arrangements is that the current taken by the coil is relatively large so that if a primary battery is used as the source of supply it very soon becomes exhausted. A further disadvantage is that the energy supplied to the pendulum is small owing to the inefficient magnet and consequently the force required to actuate the switch mechanism interferes with the isochronism of the pendulum and therefore with good time-keeping. It has been proposed to overcome the latter difficulty by electro-dynamically actuating by the motion of the magnet carried by the pendulum, a pivoted switch which is in engagement with its contacts over a considerable portion of the range of oscillation of the pendulum. In this clock the magnet is of horse-shoe shape, one of the limbs being adapted to pass through the aperture in a fixed coil, the other limb being adapted to pass through a pivoted coil attached to the switch member, the result of which arrangement is that the circuit of the magnet cannot be closed and therefore the coil takes a relatively large current.

According to my invention, I avoid the above mentioned disadvantages by using a coil of thin cross-section and a magnet or magnet system in which the air-gap length is just sufficient to allow free clearance between the coil and the magnet; that is to say, the magnetic circuit of the magnet is practically closed, and I provide on the pendulum, or balance-wheel if such be used for making and breaking the current in the coil, a light contact adapted to engage and wipe over a fixed contact so that the coil receives current preferably at the middle of the oscillation of the pendulum and through a small angle in which

the coil and field effectively interact. I therefore reduce the retarding force due to the engagement of the contacts to a very small amount and, owing to the construction and arrangement of magnet and coil, I make the driving force on the pendulum very large in comparison with such retarding force, so that its effect on the time-keeping of the clock is a minimum. Further, the construction enables much smaller magnets and coils to be used than have hitherto been possible. By energising the coil when it has its highest velocity, the large counter-electromotive force which is then developed reduces to a minimum the sparking at the contacts.

The accompanying drawings illustrate my invention:

Figure 1 being a front elevation of a pendulum type of clock,

Figure 2 a side elevation of the same,

Figure 3 a diagrammatic view of the connections.

Figure 4 shews our invention as applied to a balance-wheel type of clock and

Figure 5 is a plan view of the same.

In carrying our invention into effect, as illustrated, the pendulum *a* is fitted at its lower end with a coil *b*, of thin cross-section and preferably of rectangular shape. This coil is adapted to swing across the field between the limbs of two permanent magnets *c* and the electromagnetic damping, resisting its motion in the magnetic field, is rendered as small as possible by avoiding the use of a closed metal former for supporting the turns of the coil. The field gap of the magnets should be made as small as possible, consistent with allowing free working clearance between it and the magnet pole-faces so that an intense field is produced which is narrow in the direction of movement of the coil. The width of the coil should preferably be substantially the same as the total width of the magnetic field. On the side of the pendulum a light piece of metal or a pin *d* pivoted about a horizontal axis is fitted, this metal piece or pin being adapted to wipe over a pair of metal pins *e*. The metal piece or pivoted pin *d* is insulated from the pendulum and connected to one end of the coil *b* while the other end of the coil is connected to an intermediate point in a battery of cells *f* through the pendulum rod and the supporting column. The contact pins *e* are also insulated and are connected respectively to the terminals of the battery. The pivoted pin *d* may have a slotted pivotal mounting so that it is capable of a small amount of movement along its length.

The fixed contact pins *e* are so placed with regard to the magnets that the vertical pivoted contact will engage with one or the other according to the direction of swing of the pendulum when the pendulum is at or about the middle of its swing. In this position the coil is energised and the pendulum receives its impulse, one impulse being given on each swing. Instead of a pair of fixed contacts and two batteries being used, a single fixed contact and a single battery may be provided so that the circuit of the battery through the coil will only be closed by the pivoted contact once in a double swing.

The pendulum is arranged to actuate the clock train in any suitable manner, as, for example, by operation of a pawl *g* on a toothed ratchet-wheel *h* geared to the clock train.

The electrical connections will be clear from a consideration of Figure 3. The batteries A and B may be located within the base or in any other convenient position. One pole of the battery A is connected to one of the metal pins *e* and the other to the battery B. The other pole of battery B is connected to the other pin *e*. The pivoted pin *d* as above described makes contact with the pins *e* and is connected to one end of the coil *b* which in turn is connected through the pendulum rod and supporting column to a point C between the batteries.

In the modification illustrated in Figures 4 and 5, the coil *b* is carried on the periphery of a balance-wheel *k* mounted on a spindle *m*. The pivoted pin *d*

is carried on a pin *n* projecting from the hub of the wheel. The wheel is normally held in and returned to its mid position by means of a spring *p*. The electrical connections in this modification are the same as those described above with reference to the first modification.

It will be obvious that instead of arranging the coil on the pendulum this coil might be fixed and a magnet or magnets carried by the pendulum and further, instead of using a pendulum, a balance-wheel might be fitted with the coil or magnet and also that instead of a permanent magnet an electro-magnet excited from the battery or other source may be used.

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. In an electric clock of the type hereinbefore referred to, the employment of a thin coil in combination with a magnet having its magnetic circuit practically closed, producing a substantially uniform and intense field which is narrow in the direction of relative movement of the field and coil and a contact device adapted to energise the coil during the small portion of the total angle of oscillation, in which the coil and field interact, substantially as set forth.

2. In an electric clock as claimed in Claim 1, a pivoted contact carried by the pendulum or balance-wheel and arranged to engage and wipe over a fixed contact so as to make and break the electric circuit.

3. In an electric clock as claimed in Claim 1, a pivoted contact carried by the pendulum or balance-wheel arranged to engage a pair of fixed contacts so as to make and break the electric circuit twice during each complete stroke of the pendulum.

4. In an electric clock having a pendulum or balance wheel energised as claimed in Claim 1, a pair of magnets having short air-gaps and a moving coil adapted to pass through said gaps, the width of the coil being substantially the width of the magnetic field.

5. An electric clock comprising a pendulum, a pivoted contact carried thereby, a coil also carried by the pendulum, a pair of magnets having short field gaps through which the coil passes and a fixed contact adapted to be engaged by the pivoted contact carried by the pendulum to make and break the electric circuit.

6. An electric clock constructed, arranged and operating substantially as hereinbefore described and illustrated in the drawings.

Dated this 23rd day of December, 1909.

JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

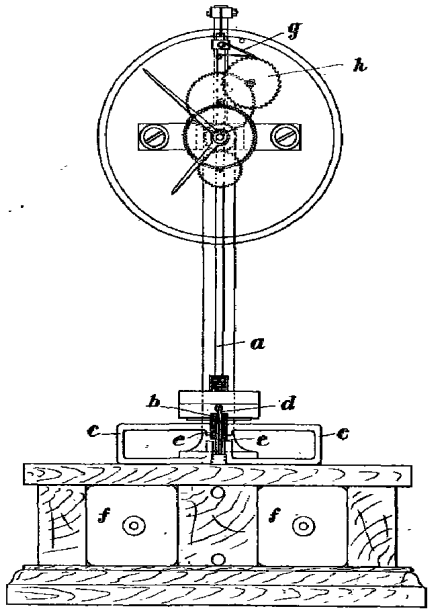
Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1910.

A.D. 1909. JUNE 26. N° 14,873.
HOLDEN'S COMPLETE SPECIFICATION.

(8 SHEETS)

SHEET 1.

Fig.1.



SHEET 2

Fig.2.

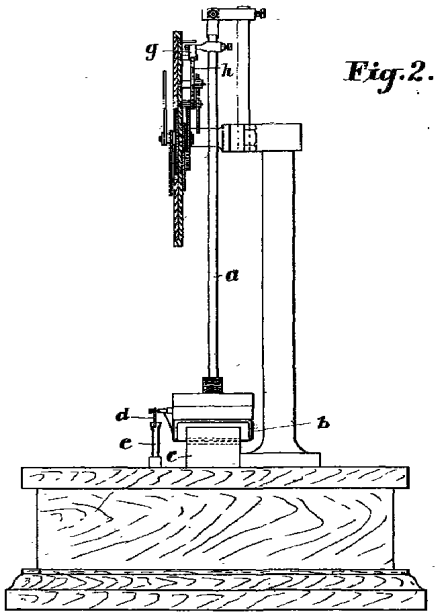
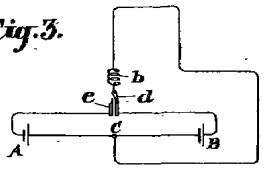
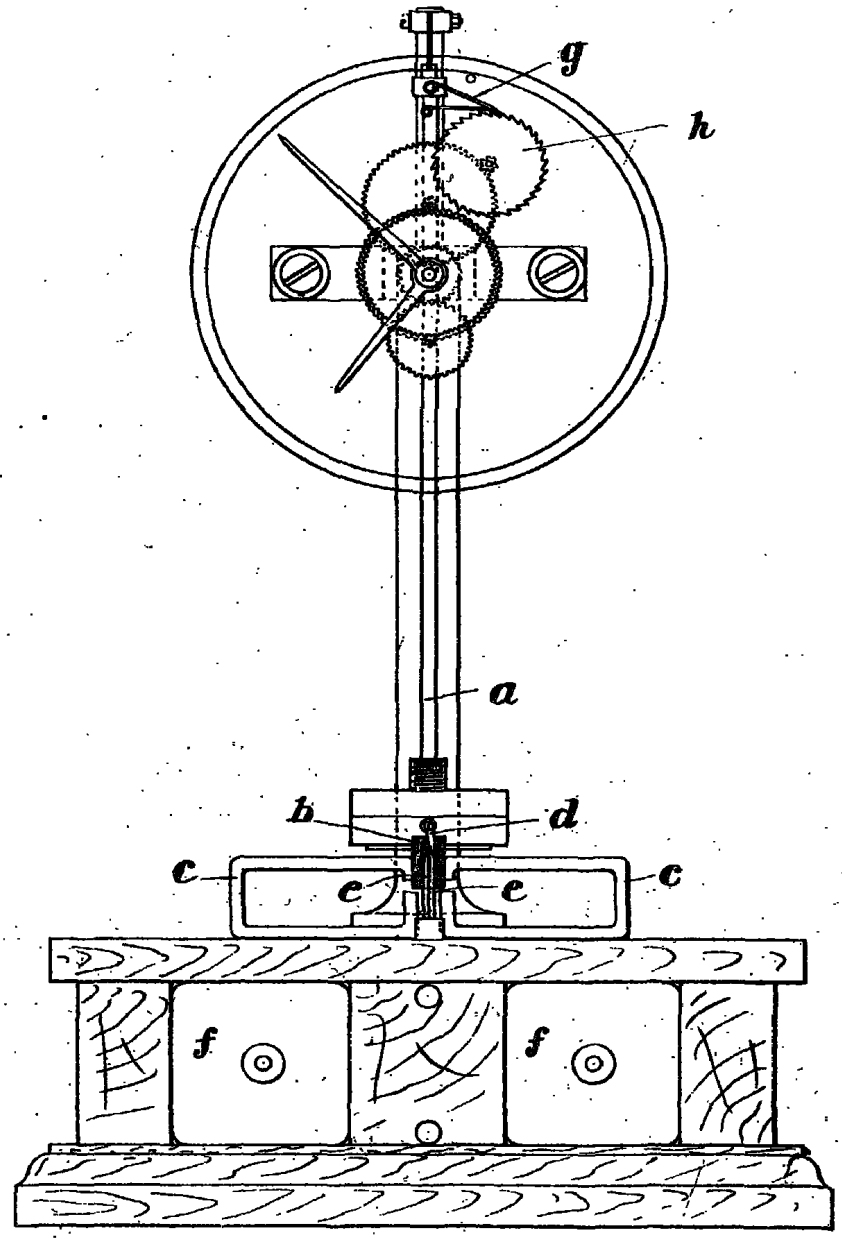


Fig.3.



Malby&Sons Photo-Litho

Fig. 1.



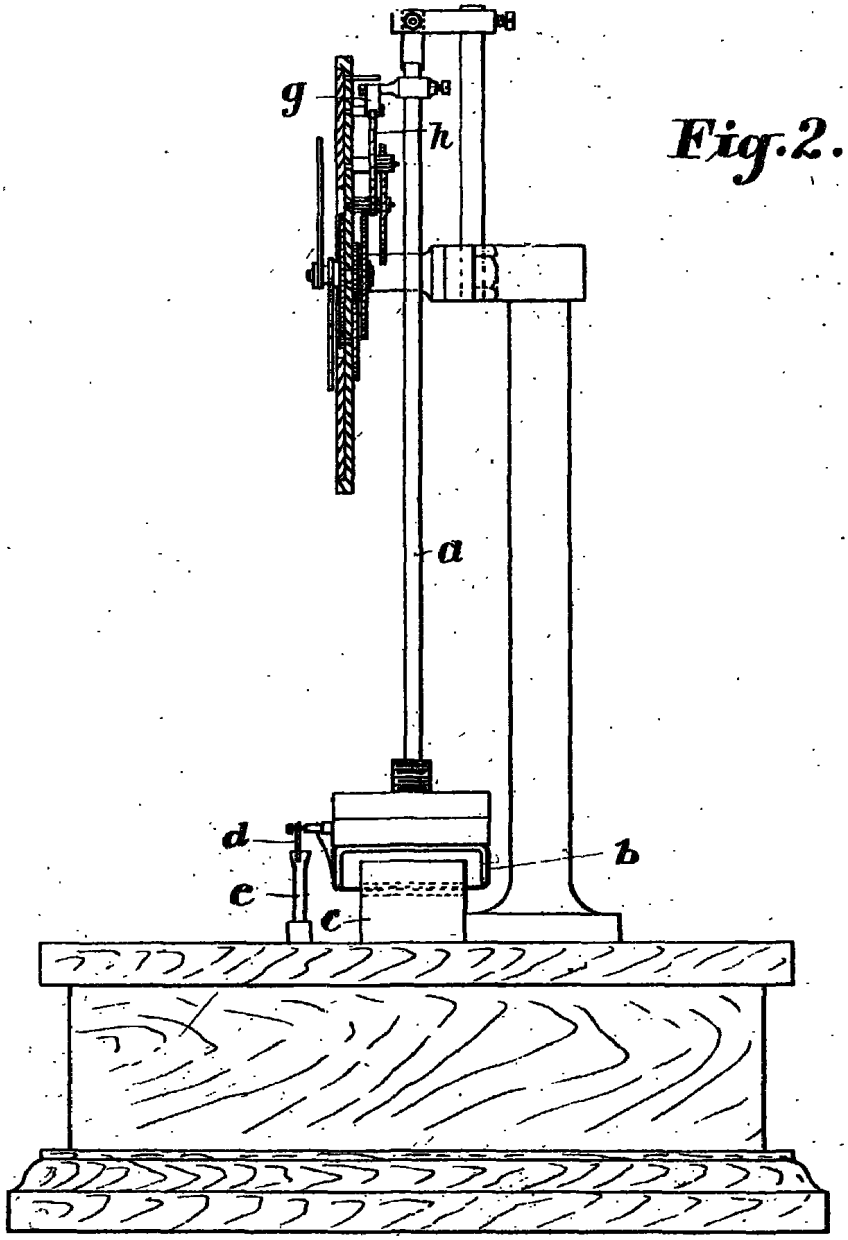
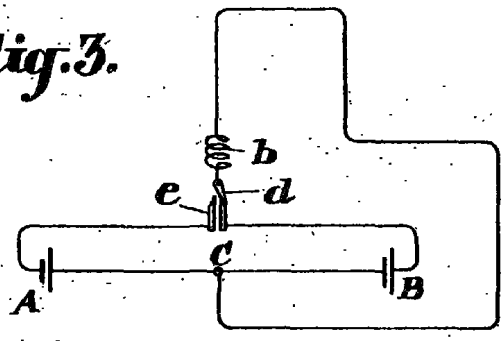


Fig. 2.

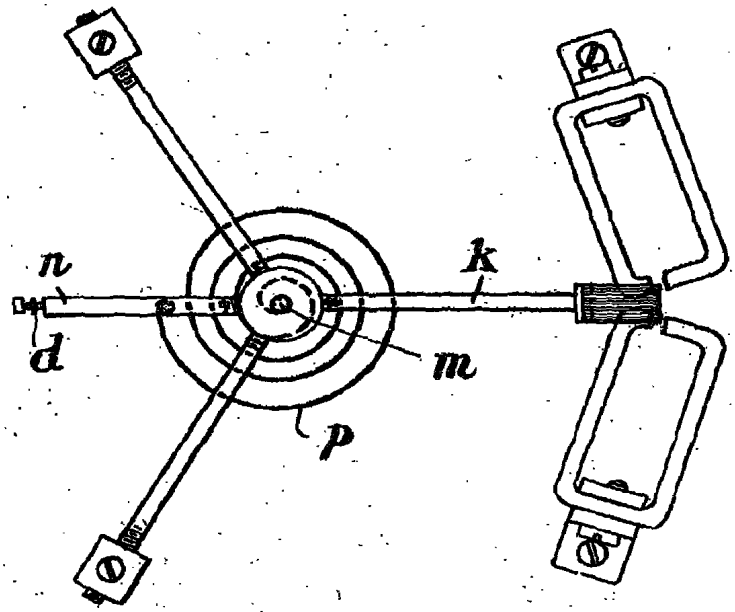
Fig. 3.



Malby&Sons, Photo-Litho

[This Drawing is a full-size reproduction of the Original.]

FIG 5



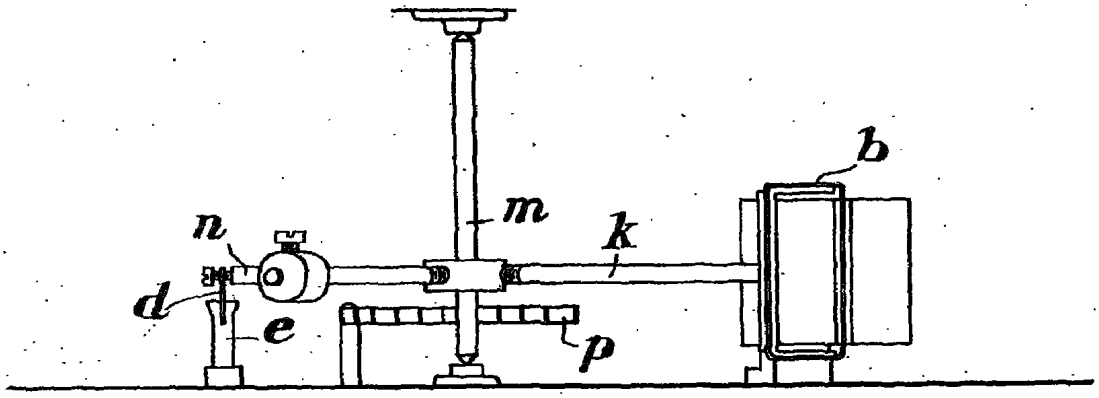


FIG. 4.

Malby & Sons, Photo-Litho.