

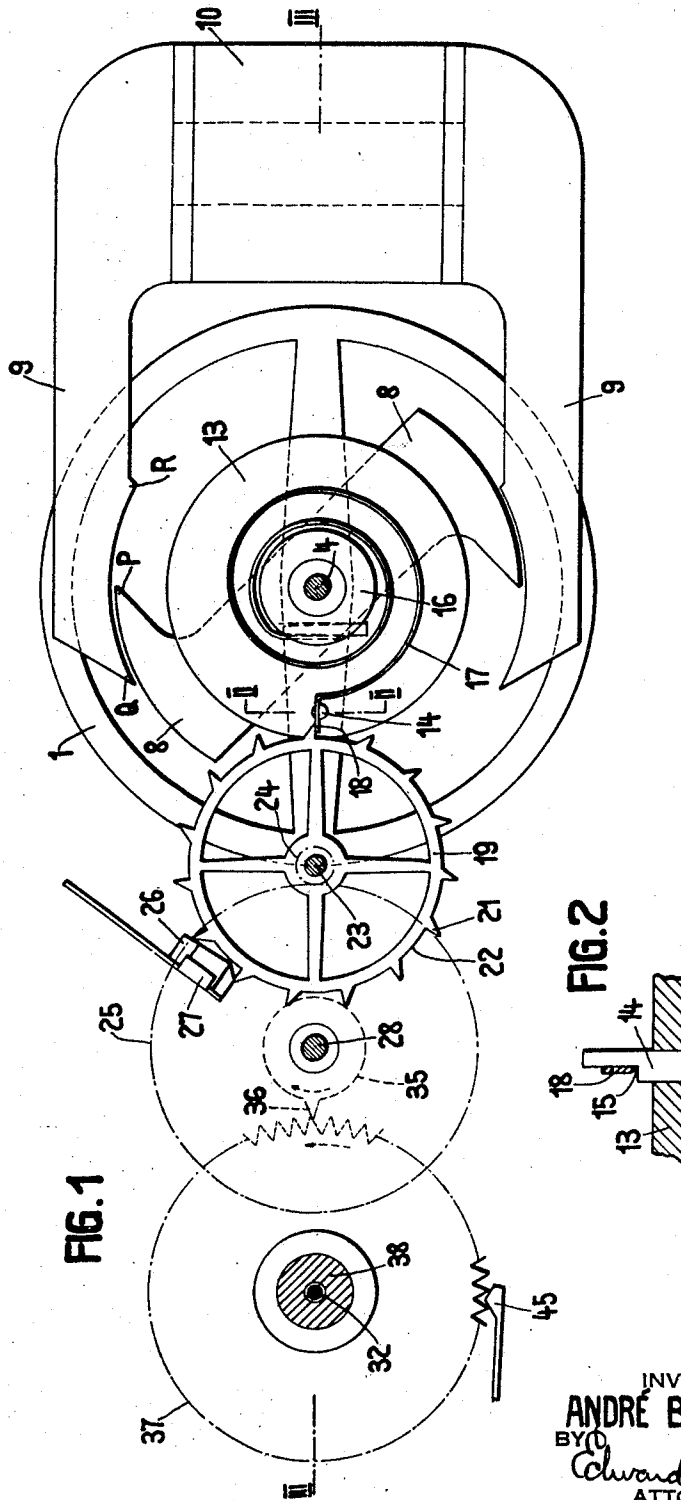
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A. BEYNER
ELECTRIC WATCH

2,845,772

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2 Sheets-Sheet 1



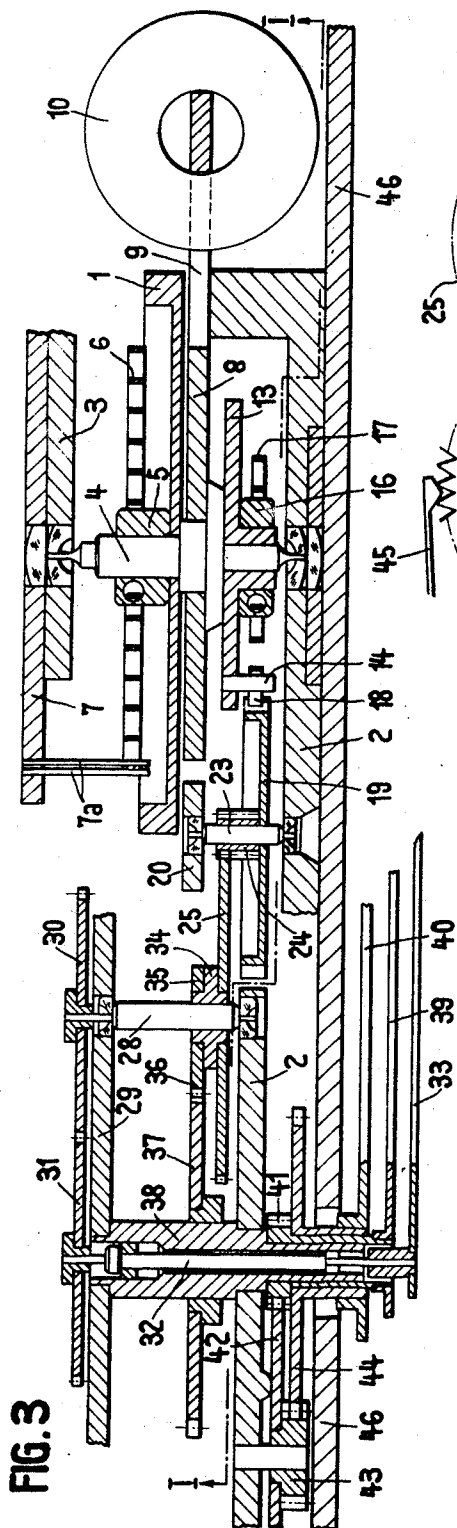
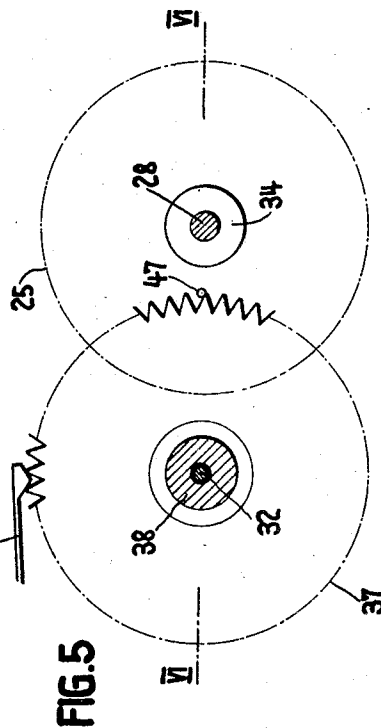
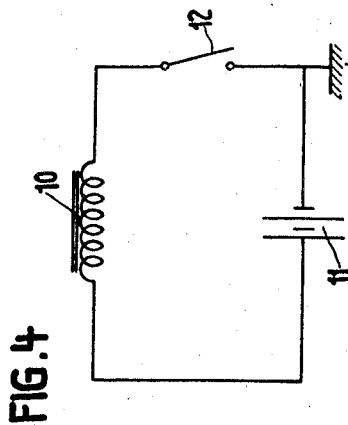
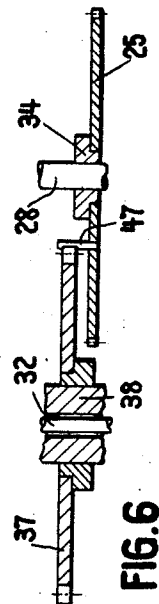
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ELECTRIC WATCH

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The present invention relates to a watch comprising a balance the oscillations of which are sustained electrically and a counting train of wheels driven by the balance and controlling the hands of the watch.

This watch is characterized in that the portion of the train of wheels that controls the minute hand and the hour hand is rotated only intermittently and with a cadence which is lower than the frequency of the oscillations of the balance.

The accompanying drawings show, by way of example, an embodiment of the invention.

Fig. 1 is an underview of this embodiment along the line I—I of Fig. 3.

Fig. 2 is a cross-sectional view taken along the line II—II of Fig. 1.

Fig. 3 is a cross-sectional view taken along the line III—III of Fig. 1.

Fig. 4 is a diagram of the circuit sustaining the oscillations of the balance.

Fig. 5 is a top plan view of a modification.

Fig. 6 is a cross-sectional view taken along the line VI—VI of Fig. 5.

The electric watch shown in the drawings comprises a balance 1 serving both as the driving element and the regulating element of the watch. The balance 1 is pivoted in the pillar plate 2 and in the balance cock 3. On the balance staff 4 there is fixed a collet 5 to which is attached the inner end of a hairspring 6 of usual type. The outer end of the hairspring 6 is fixed to the balance cock 3, for instance by means of a stud. A regulator 7 of conventional construction, carrying pins 7a, enables the active length of the hairspring 6 to be adjusted in a known manner.

A movable armature 8 is secured to the balance staff 4. It passes between the pole shoes 9 of an electromagnet provided with a coil 10 of the electric circuit shown in Fig. 4. The coil 10 is connected on the one side to a battery 11 and on the other side to a switch or interrupter 12, described later, which is connected to the battery 11 (Fig. 4).

A driving disc 13 is also fixed to the balance staff 4. The disc 13 carries a pin 14 extending downward (Fig. 3). This pin 14 has at its free end a cut-out portion 15 (Fig. 2). On the hub of the disc 13 there is secured a collet 16 in which is fixed the inner end of a spiral spring 17 of noble metal, which will thereafter be referred to as the escape spring. The other end 18 of the escape spring 17 bears resiliently against the cut-out portion 15 of the pin 14 (Fig. 2).

An escape wheel 19 is arranged near the balance 1. It is pivoted in the pillar plate 2 and in a bridge 20. The wheel 19 has gullet teeth 21 which are separated from each other by segments 22 of the hoop of the wheel 19. The spindle 23 of the wheel 19 carries a pinion 24 meshing with a transmission wheel 25 controlling the hands of the watch.

A jumper 26 cooperates with the teeth 21 of the

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wheel 19. It is made of an insulating material, for instance of ruby, and is partially covered with a metallic pellicle 27 the function of which will be explained later.

The spindle 28 of the transmission wheel 25 is pivoted in the pillar plate 2 and in the train wheel bridge 29. At its upper end, above the bridge 29, the spindle 28 carries a wheel 30 meshing with a wheel 31 carried by the second hand spindle 32. At its opposite end the spindle 32 carries the second hand 33 which is in the present example a sweep second hand. The wheels 30 and 31 have the same diameter and the same number of teeth.

On the hub 34 of the transmission wheel 25 there is fixed a ring 35 provided with a finger 36 adapted to cooperate with the teeth of a center wheel 37 of sixty teeth, rigidly fixed to a hollow spindle 38 carrying the minute hand 39. The movement of the center wheel 37 is transmitted to the hour hand 40 by means of a usual train of gears: cannon pinion 41, minute wheel 42 with pinion 43, hour wheel 44. A jumper 45 cooperates with the teeth of the center wheel 37. The dial is denoted by the reference numeral 46.

The electric watch as shown and described works as follows:

The electric circuit sustaining the oscillations of the balance 1 comprises the battery 11, a pole of which is connected to the earth (frame of the movement), the other pole of the battery 11 being connected to the coil 10 and then to the interrupter 12 (Fig. 4). The interrupter 12 is actually formed by two contacts arranged in series, viz. the contact between a tooth 21 of the escape wheel 19 and the metallic pellicle 27 of the jumper 26 and, on the other hand, the contact between another tooth 21 of the wheel 19 and the escape spring 17. The interrupter 12 is closed periodically when the balance 1 oscillates, as it will be seen later.

At the beginning of the closing of the interrupter 12, the point P of the movable armature 8 is placed opposite the point Q of the pole shoe 9. The reluctance of the magnetic circuit is great and decreases considerably as the armature 8 penetrates within the pole step QR. The angular position of the armature 8 on the balance staff 4 is such that the interrupter 12 opens when the point P arrives opposite the point R. The armature 8 is shown in Fig. 1 in its position of equilibrium, which also corresponds to the position of equilibrium of the balance 1.

The escapement formed by the members 13 to 19 acts simultaneously as an electric interrupter and as a device transmitting the force from the driving balance 1 to the counting train of wheels of the watch. Let us assume at first that the balance 1 turns in the clockwise direction of Fig. 1. The pin 14 carried by the disc 13 holds the outer end 18 of the escape spring 17, which comes into contact with the radial flank of one of the teeth 21 of the wheel 19 and drives the latter by one angular step. During a fraction of the duration of the mechanical contact between the spring 17 and the tooth 21, the electric contact is made through a circuit sustaining the oscillations of the balance 1, comprising the frame of the movement (cock 3) acting as earth or ground, the hairspring 6, the balance staff 4, the escape spring 17, the escape wheel 19, the metallic pellicle 27 of the jumper 26, the coil 10 and the battery 11. This contact is then broken owing to the diverging angular movements of the balance 1 and of the escape wheel 19. The balance 1 is then free and travels over the first supplementary arc of vibration. On the return motion of the balance 1, under the action of the hairspring 6, the free end 18 of the escape spring comes into contact with the inclined flank or back of one tooth 21 of the wheel 19. The end 18 does not remain any longer against the pin 14, but yields resiliently and

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slides on the flank of the said tooth 21, until it escapes from the point of that tooth and falls again on the pin 14. Owing to the provision of the jumper 26, the escape wheel 19 is not driven on this return motion of the balance 1, and also no electric contact is closed, as only the non-metallic portion of the jumper 26 is in contact with the teeth 21 of the wheel 19. The balance 1 is then free and travels over the second supplementary arc of vibration, until it comes back into its original position under the action of the hairspring 6, and the cycle described takes place again. The balance 1 receives, therefore, only one driving impulse during one double oscillation.

The particular arrangement of the jumper 26 has two aims in view: On the one hand, the electric contact is made only when the balance is rotated in the clockwise direction of Fig. 1; on the other hand, if, for any reason, the watch stops in the position shown in Fig. 1, the battery 11 will not discharge in vain.

The collet 16 can be displaced angularly with respect to the balance staff 4, so as to adjust the point of the phase of its movement where the end 18 of the escape spring 17 comes into contact with the wheel 19.

The contact pressure of the escape spring 17 with the teeth 21 of the wheel 19 is high owing to the fact that the closing of this contact simultaneously causes the train of wheels of the watch to be driven.

It has already been explained that, when the balance 1 oscillates, the escape wheel 19 is turned step by step in a unidirectional movement. The wheel 19 drives, through its pinion 24, the transmission wheel 25. The escapement is constructed such that the wheel 25 is rotated with a speed of one R. P. M. The movement of this wheel is transmitted to the second hand 33 through the wheels 30 and 31. The second hand 33 is therefore driven step by step at the same cadence as that of the escape wheel 19 (for instance twice a second).

On the contrary, as the transmission wheel 25 drives the center wheel 37 by means of the finger 36, the minute hand 39 moves once a minute. The jumper 45 keeps the center wheel 37 unmoved between two successive jumps. The hour hand 40 is in turn actuated once a minute, through the intermediary of the parts 41 to 44.

Instead of having only one finger 36, the ring 35 might have several fingers. In that case, the center wheel 37 should have a number of teeth equal to the number of these fingers multiplied by sixty. For instance, if the ring 35 has four fingers, the wheel 37 will have 240 teeth, and will do a jump every quarter of a minute, the hand 39 being each time advanced by a quarter of a minute-division on the dial 46.

According to a modification shown in Figs. 5 and 6, the ring 35 and its finger or fingers 36 may be replaced by one or several pins 47 directly fixed to the disc of the transmission wheel 25, and it is then this pin 47 which intermittently actuates the center wheel 37.

The counting train of wheels as described and shown enables to spare a great portion of the energy lost by friction in the mechanical watches. Indeed, only a portion of the train of wheels is turned at each oscillation of the balance, the remaining portion of the train being driven only intermittently. Owing to the fact that this train is only a counting one, i. e. it transmits no driving torque, the pressures on the pivots are very low and the starting frictions are minimized.

It might at first seem that the force necessary for driving for instance the minute hand once a minute should be equal to that which is necessary for moving the same hand by the same angle sixty times per minute. As a matter of fact, the necessary force is much greater in the second

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case, as the starting friction is greater than the sliding friction. Thanks to the described device, it is avoided having to overcome, at each oscillation of the balance, the inertia of the whole train of wheels. The regulating of the watch is facilitated, as the oscillations of the balance are independent of a portion of the train of wheels during long time intervals.

It should be noticed that the train of wheels comprises only two pinions, viz. the escape pinion 24 and the minute wheel pinion 43. The three pinions of the standard train of wheels (center pinion, third wheel pinion and fourth wheel pinion) are missing.

In addition, the described train of wheels is arranged in a very small portion of the watch movement, in order to leave to the regulating and driving elements of this watch as much room as possible. The inertia of the train of wheels is thus minimized, sparing the energy for driving it.

I claim:

1. In an electric watch movement of the type including coaxially mounted second, minute, and hour hands with toothed center wheels for the seconds and minutes hands, a train wheel bridge, gearing for transmitting movement of the minutes center wheel to the hour hand, an escape wheel, a driving oscillating balance for the escape wheel, and a gear train operatively connecting the escape wheel with the hands, the improvement wherein the gear train includes an intermediate wheel, a spindle for the intermediate wheel, the intermediate wheel driven by the escape wheel, a toothed wheel carried by the spindle for the intermediate wheel and driving the seconds center wheel, at least one intermittent driving element carried by the spindle for the intermediate wheel and driving the minute hand center wheel forward a distance of the width of one tooth of said minute hand center wheel for each revolution of the driving element, the toothed wheel being rigidly attached to the spindle and positioned outwardly of the train wheel bridge, the toothed wheel having the same number of teeth as the seconds center wheel whereby the minute hand center wheel is actuated intermittently with a frequency which is lower than the frequency of oscillation of the balance and the seconds hand is driven at each oscillation of the balance.

2. A watch gear train according to claim 1 in which the intermediate driving element is of n elements and rotates once per minute to intermittently move the minute hand center wheel n times per minute.

3. A watch gear train according to claim 1 in which the intermittent driving element is a finger carried by a ring rigidly attached to the intermediate wheel.

4. A watch gear train according to claim 1 in which the intermittent driving element is a pin rigidly attached to the intermediate wheel.

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