

Device for electromechanical watch for determining the moment
at which and the direction in which a time indication has to be
corrected

The present invention concerns a device for an electromechanical watch for determining the moment at which and the direction in which a time indication has to be corrected. More specifically, the present invention concerns a device for an electromechanical watch allowing an electronic
5 control circuit of the watch movement to determine the direction of rotation of an indicator showing a magnitude of time, driven by the watch movement, and the moment when the magnitude of time has to be respectively incremented or decremented.

An electromechanical watch is a watch whose indicators are driven
10 by a single motor or by several separate motors. An example of this type of electromechanical watch is shown schematically in Figure 1, annexed to this Patent Application. Designated as a whole by the general reference number 1, this electromechanical watch is the type with a retrograde perpetual calendar. It includes a first centre hand display 2, a second hand
15 display 4 at 6 o'clock, a third hand display 6 at 2 o'clock and a fourth hand display 8 at 10 o'clock.

The first hand display 2 includes, in a conventional manner, an hour hand 2a and a minute hand 2b which move above a dial 10. The first hand display 2 is completed by a date hand 2c which moves backwards along an
20 index in an arc of a circle 12 which bears the date indications from "1" to "31". The second hand display 4 includes a small seconds hand 4a. The third hand display 6 includes a hand 6a indicating the days of the week

which moves backwards along an index in an arc of a circle 14, on which the days of the week from Monday to Sunday are marked. The fourth hand display 8 includes an hand 8a indicating the months of the year which moves backwards along an index in an arc of a circle 16 on which the months of the year are marked. It will be noted that the current year is indicated when the date of watch 1 is set by means of date hand 2c which is moved opposite one of the figures "1", "2", "3" or "4" of sector 12 depending upon whether the year during which the date of watch 1 is set is the first, second or third year preceding a leap year which is represented by the figure "4".

The retrograde perpetual calendar watch 1, shown in Figure 1, is completed by a stem 18 which can occupy a neutral position T1, a first pulled out position T2 and a second pulled out position T3, and two correctors 20 and 22. This electromechanical watch is also driven by four distinct motors. A first motor drives the first hand display 2, namely hour hand 2a and minute hand 2b, and small seconds hand 4a of the second hand display 4. A second motor drives the date hand 2c, a third motor drives day of the week indicator hand 6a and a fourth and final motor drives month of the year indicator hand 8a. These four motors are powered by a battery.

The electromechanical watch 1 briefly described above can be handled in four distinct ways during the assembly and daily use thereof. After watch 1 has been assembled or when the battery is changed, the hands are set at their original position. In other words, the position of all the hands of watch 1 is reset. The second manipulation concerns setting the time of watch 1 which is achieved either during assembly of watch 1, or when the battery is changed. The third manipulation concerns setting the date of watch 1 which must be carried out when the battery is inserted or changed. Finally, the fourth operation relates to a change of time zone.

The operation of resetting the position of the hands allows these hands to be returned to reference positions so that the electronic control

circuits of watch 1 can store these reference positions and calculate all of the subsequent movements of the hands from said positions. Date indicator hand 2c, day of the week indicator hand 6a and month of the year indicator 8a are reset to their original position. In other words, date indicator hand 2c
5 is moved to the first day of the month, day of the week indicator hand 6a is moved to Monday and month of the year indicator hand 8a is moved to January.

Hour and minute hands 2a and 2b are set to the time mechanically with stem 18 in pulled out position T3. The hour and minute are adjusted by
10 rotating stem 18. When the time is set, the AM and PM positions of hands 2a, 2b should be respected. During this operation of setting the time of watch 1, date indicator hand 2c, day of the week hand 6a and month of the year hand 8a indicate a given date.

The operation of setting the date of watch 1 is performed electrically
15 by means of stem 18 in pulled out position T3 and the two correctors 20 and 22. The order of selection of the hands starts with the year (hand 2c) and continues with the month (hand 8a), the date (hand 2c) and the day (hand 6a) and finally returns to the year. An application of pressure on corrector 22 moves the selected indicator hand one step forwards in the
20 positive direction. An additional application of pressure on corrector 20 confirms the selected value and causes the next hand to move.

Finally, the time zone change operation is performed in the same way as the time-setting operation of the watch. However, this latter operation raises a problem. Indeed, when the time zone is being changed, it
25 must be possible to detect when the time changes to midnight in order to synchronize the date change with the change of day. Moreover, the direction of the time correction also needs to be known when there is a time zone change since this change affects not only the date indication but may also affect the day of the week indication, and the month and year
30 indication. In other words, the whole of the kinematic chain, which will be termed "digital" in that it is formed of motors that are mutually independent

and the operation thereof is managed by the electronic control circuits of the watch, is affected by the time zone change.

It is an object of the present invention to overcome this problem by providing a device for an electromechanical watch that can determine the
5 moment at which and the direction in which a time indication has to be corrected.

This invention therefore concerns a device for an electromechanical device allowing an electronic control circuit of the watch movement to determine the moment at which and the direction in which an indication
10 showing a magnitude of time has to be corrected, said device including a wheel which is driven by the watch movement and carries means for actuating first and second detection means connected to the electronic control circuit, the electronic control circuit deducing, from the moment at which and the order in which the first and second detection means are
15 actuated by the actuating means of the wheel driven by the watch movement, the direction in which the wheel is being driven by the movement and the moment when the magnitude of time has to be respectively incremented or decremented.

Owing to these features, this invention provides a device which
20 enables an electronic control circuit of an electromechanical watch to detect the change in time to midnight in order to synchronize the change in a time related parameter, like the date indication, with the change of day. Moreover, since the electronic control circuit receives information as to the order in which the first and second detection means have been actuated by
25 the actuating means of the wheel driven by the watch movement, the electronic control circuit is also aware of the direction of the time change. It can then synchronize the entire electronic kinematic chain which connects it to mutually independent motors that each drive a counter which can be affected by the time change.

30 Other features and advantages of the present invention will appear more clearly from the following detailed description of one embodiment of

the device according to the invention, this example being given solely by way of non-limiting illustration with reference to the annexed drawing, in which:

- Figure 1 is a plan view of an electromechanical watch with the retrograde perpetual calendar fitted with the device according to the invention;

- Figure 2A is a perspective view of an electronic module which carries three studs standing perpendicularly to the surface of the electronic module;

10 - Figure 2B is a perspective view of an additional plate on which the electronic module of Figure 2A is intended to be assembled;

- Figure 2C illustrates an assembled electronic unit associating the electronic module of Figure 2A and the additional plate illustrated in Figure 2B;

15 - Figure 2D is a perspective view of a motor module of the electromechanical watch according to the invention;

- Figure 2E is a perspective view of the assembled electronic unit illustrated in Figure 2C assembled with the motor module of Figure 2D;

20 - Figure 2F is a perspective view of the motor module of Figure 2E including first and second detection means of the device according to the invention;

- Figure 2G is a similar view to that of Figure 2F showing that the wire springs are vertically locked;

25 - Figure 2H is a similar view to that of Figure 2G showing that a washer is engaged on the earthing stud;

- Figure 2I is a similar view to that of Figure 2H showing that an actuating wheel is engaged on the earthing stud after the washer;

- Figure 2J is a similar view to that of Figure 2I showing an hour wheel driven by the cannon-pinion of the watch;

- Figure 2K is a similar view to that of Figure 2J showing that the actuating wheel is driven at a rate of one complete revolution per twenty-four hours by the hour wheel via an intermediate wheel;

- Figure 2L is a similar view to that of Figure 2K showing that the
5 entire device is covered by a holding plate;

- Figures 3A to 3H are top views of the detection mechanism according to the invention at different stages in the operation thereof, and

- Figure 4 is a timing diagram showing the evolution of the signals supplied by the first and second detection means as a function of the
10 rotation of the actuating wheel.

The present invention proceeds from the general inventive idea that consists in fitting an electromechanical watch, which includes mutually independent motors each driving an indicator showing a magnitude of time, with a device connected to the electronic control circuit of the watch and
15 capable of determining at what moment and in which direction the time changes to midnight. With this information available, the electronic control circuit of the watch is able to synchronize all of the motors and operate the forward or backward movement of the indicators affected by the time change.

20 The structure of the detection device according to the invention will first of all be examined. The operation of this detection device will be examined in a second part.

Figure 2A is a perspective view of an electronic module 24 which carries three studs 26, 28 and 30, which stand perpendicularly to the
25 surface of the electronic module 24 and whose roles will be described in detail below. Electronic module 24 is mounted on an additional plate 32 (see Figure 2B) to form an assembled electronic unit 34 illustrated in Figure 2C. Figure 2D is a perspective view of a motor module 36 of electromechanical watch 1 according to the invention, which has, in
30 particular, three apertures 38a, 38b and 38c allowing three studs 26, 28 and

30 of electronic module 24 to pass therethrough, after the assembled electronic unit 34 has been assembled with the motor module 36 of electromechanical watch 1 (see Figure 2E). Without entering into the design details of motor module 36 of electromechanical watch 1 according to the invention, which is not the subject of this Patent Application, the presence of a motion work wheel 38, which drives a cannon-pinion 40 placed at the centre of motor module 36, may nonetheless be noted. It is noted that as shown in Figure 2E, stem 18 is in the pulled out time-setting position T3.

Reference will now be made to Figure 2F which shows an alternative embodiment of the first and second detection means of the device according to the invention. According to this embodiment, given purely by way of illustration, each of the first and second detection means, respectively designated by the reference numerals 42 and 44, is formed by a wire spring 46a, 46b wound around itself in one or several coils 48a, 48b so as to be able to engage on the corresponding stud 25, 56. It will be noted that stud 56 is a stud made of a non-conductive plastic material which is integral with the plate of motor module 36. Wire springs 46a, 46b are folded into a substantially V-shape and thus have two arms 50a, 52a and 50b, 52b which are symmetrical relative to windings 48a, 48b.

As will be seen below, arms 52a and 52b of the two wire springs 46a, 46b form electrical contacts by being brought to a floating electrical potential by studs 26 and 30. The position of these contact arms 52a, 52b is guaranteed by winding and tightening to wire springs 46a, 46b. Thus, arms 50a, 50b of the two wire springs 46a, 46b are stopped, one by a stop member 54 made of a non-conductive plastic material which is integral with the plate of motor module 36 and the other by contact 30, while the other two arms of wire springs 46a, 46b are slid into slots 58 and 60 so as to form a preferred angle α of 60° between them. Consequently wire spring 46a is stopped from pivoting clockwise, while wire spring 46b is stopped from pivoting anticlockwise. Finally (see Figure 2G), wire springs 46a, 46b are stopped vertically by means of two washers 62 and 64 engaged on studs

26, 56 after wire springs 46a, 46b. It can also be seen upon examining Figure 2H that a disc spring or washer 66 is engaged on stud 28.

An actuating wheel 68 is engaged on stud 28 after a disc spring 66 (see Figure 2I). This wheel 68, arranged above wire springs 46a, 46b is
5 earthed by stud 28. It is fitted with two cylindrical pins 70 and 72 which project underneath the bottom surface thereof and which are arranged to be able to come into contact with the arms 52a, 52b of wire springs 46a, 46b. These pins 70, 72 form a preferred angle β of 102° between them. The actuating wheel 68 is driven at the rate of one complete revolution per
10 twenty-four hours by an hour wheel 74 (see Figure 2J) via an intermediate wheel 76 (see Figure 2K).

The operating principle of the actuation device according to the invention is set out below. Actuating wheel 68, driven by hour wheel 74 via intermediate wheel 76 makes one complete revolution in twenty-four hours.
15 This actuating wheel 68 and thus pins 70 and 72 carried thereby are earthed through stud 28 on which wheel 68 is engaged. The function of the two wire springs 46a, 46b, located underneath actuating wheel 68, is to pick up electrical signals. When actuating wheel 68 rotates, the pins 70 and 72 carried by said wheel 68 come into contact in sequence with contact arms
20 52a, 52b of the two wire springs 46a, 46b and force the potential of said two springs 46a, 46b to earth. The electronic control circuit to which the two wire springs 46a, 46b are connected interprets the signals received from wire springs 46a, 46b and generates the impulses necessary to operate the motors. More specifically, depending upon whether actuating wheel 68 is
25 rotating clockwise or anticlockwise when the time of electromechanical watch 1 according to the invention is being set or the time zone changed, the order in which pins 70 and 72 touch contact arms 52a, 52b of the two wire springs 46a, 46b is reversed, such that the electronic control circuit of watch 1 can deduce, from the order in which contact arms 52a, 52b are
30 touched by pins 70, 72, the direction (clockwise or anticlockwise) in which actuating wheel 68 and therefore hour wheel 74 is rotating. Further, pins 70,

72 and contact arms 52a, 52b of the two wire springs 46a, 46b are arranged such that pins 70, 72 only touch contact arms 52a 52b simultaneously once per day. As the potential of one of contact arms 52a, 52b has been forced to earth by one of pins 70 or 72, the electronic control
5 circuit of watch 1 deduces, from the moment at which the potential of the other contact arm is forced to earth by the other pin, the instant when hour wheel 74 changes to midnight. The electronic control circuit of watch 1 therefore knows in which direction hour wheel 74 is rotating and the moment at which the latter changes to midnight, such that it can operate the
10 motors of watch 1 in an appropriate manner to correct the displays.

Finally, the assembled electronic unit 34 and motor module 36 of electromechanical watch 1 are covered by a holding plate 78 (see Figure 2L) against which the disc spring or washer 66 presses actuating wheel 68 to earth said wheel.

15 An operating sequence of the detection device according to the invention will now be examined in detail with reference to Figures 3A to 3H and the timing diagram shown in Figure 4. It is assumed for the purposes of the description that stem 18, pulled into position T3, is turned manually to set the time or correct the time zone such that actuating wheel 68 is rotating
20 clockwise.

In Figure 3A it is observed that neither of pins 70, 72 is touching one of contact arms 52a, 52b of the two wire springs 46a, 46b. The level of the signals produced by wire springs 46a, 46b is at "0".

In Figure 3B, actuating wheel 68 has rotated clockwise and pin 70
25 has moved to touch contact arm 52a, forcing the potential of wire spring 46a to earth. The signal produced by wire spring 46a and transmitted to the electronic control circuit of watch 1 changes to level "1" while the level of the signal produced by wire spring 46b remains at "0".

In Figure 3C, actuating wheel 68 has continued to rotate. The contact
30 between pin 70 and contact arm 52a has been broken, such that the signal

produced by wire spring 46a drops back to zero. At the same time, the second pin 73 is not touching either of wire springs 46a, 46b. The signals produced by the two wire springs remain at zero.

5 In Figure 3D, actuating wheel 68 has continued to rotate. While pin 70 is not touching either of the two wire springs 46a, 46b, pin 72 has moved to touch contact arm 52a, forcing the potential of wire spring 46a to earth. The signal produced by wire spring 46a and transmitted to the electronic control circuit of watch 1 changes to level "1" while the level of the signal produced by wire spring 46b remains at "0".

10 In Figure 3E, actuating wheel 68 has continued to rotate. While pin 72 has remained in contact with contact arm 52a of wire spring 46a and is thus keeping the potential of wire spring 46a at earth, pin 7 has moved to touch contact arm 52b of wire spring 46b and thus forces the potential of wire spring 46b to earth too. The signal produced by wire spring 46a and
15 transmitted to the electronic control circuit of watch 1 therefore remains at level "1", whereas the signal produced by wire spring 46b changes from "0" to "1". At this precise moment, the signals produced by the two wire springs 46a and 46b are both at level "1". This situation only occurs once every twenty-four hours and is interpreted by the electronic control circuit of watch
20 1 as marking the change of time to midnight on the rising edge of the signal produced by wire spring 46b. The electronic control circuit of watch 1 is thus able to synchronize all of the motors and operate the forward or backward movement of the indicators affected by the time change or time zone change.

25 In Figure 3F, actuating wheel 68 has continued to rotate. The contact between pin 72 and contact arm 52a has been broken, such that the signal produced by wire spring 46a drops back to zero. At the same time, the first pin 70 is still in contact with wire spring 46b whose signal level remains at "1".

30 In Figure 3G, actuating wheel 68 has continued to rotate. The contact between pin 70 and contact arm 52b has been broken, such that

the signal produced by wire spring 46b drops back to zero. At the same time, the first pin 70 is not touching either of wire springs 46a, 46b. The signals produced by the two wire springs 46a, 46b are therefore at zero.

In Figure 3H, the actuating wheel has continued to rotate. While the first pin 70 is not touching either of wire springs 46a, 46b, the second pin 72 has moved to touch contact arm 52b of the second wire spring 46, forcing the potential of wire spring 46 to earth. The signal produced by the first wire spring 46a remains at zero, whereas the signal produced by the second wire spring 46b changes to one.

Beyond this position, the cycle starts again from the beginning as illustrated in Figure 3A.

The timing diagram shown in Figure 4 illustrates the potential evolution of the contact arm respectively 52a, 52b of wire springs 46a, 46b as a function of the change in position of the first and second pins 70 and 72 as shown in Figures 3A to 3H. In other words, the timing diagram of Figure 4 illustrates the change in potential of studs 26 and 30 and thus the value of the electrical signals applied to the watch control circuit. It will be noted that if one complete 360° rotation of actuating wheel 68 is considered over a twenty-four hour period, the angular range during which the electrical potential of studs 26 and 30 changes is substantially comprised between 105° and 360°. It will also be noted that the angular range during which the electrical potential of one of studs 26 or 30 is at one extends over approximately 45° which corresponds to a duration of three hours.

It will be clear that, depending upon whether actuating wheel 68 is rotating clockwise (as assumed here) or anticlockwise, the order in which the two wire springs 46a, 46b alternately change from level zero to level one is reversed. The electronic control circuit of watch 1 thus deduces, from the order in which wire springs 46a, 46b are contacted by pins 70, 72, the direction in which actuating wheel 68 has rotated and thus the direction of time correction or time zone change applied to watch 1. The electronic control circuit of watch 1 is thus able to operate the forward or backward

movement of the indicators affected by the time change or time zone change. Moreover, the moment when the potential of one of the wire springs is forced to earth while the other wire spring is already at earth marks the change of the watch display through midnight, which enables the
5 control circuit to synchronize the jumps of all of the motors of watch 1.

It will be noted that the system that has just been described has very little interference or rebounds even after reliability testing. Moreover, as the wire springs are positioned and prestressed, the manufacturing tolerances of these components do not affect the precision of the contact between the
10 pins and the wires springs.

CLAIMS

1. Device for electromechanical watch (1) allowing an electronic control circuit of the watch (1) movement to determine the moment at which and the direction in which an indication showing a time related parameter
5 has to be corrected, said device including a wheel (68), which is driven by the watch (1) movement and carries means (70, 72) for actuating first and second detection means (46a, 46b) connected to the electronic control circuit, said electronic control circuit deducing, from the moment at which and the order in which the first and second detection means (46a, 46b) are
10 actuated by the actuating means for the wheel (68) driven by the watch (1) movement, the direction in which the wheel (68) is being driven by the movement and the moment when the time related parameter has to be respectively incremented or decremented.

2. Device according to claim 1, characterized in that the wheel
15 (68) which carries the actuating means (70, 72) for the first and second detection means (46a, 46b) is earthed, whereas the first and second detection means (46a, 46b) are brought to a floating electrical potential.

3. Device according to claim 2, characterized in that the actuating wheel (68) makes one complete revolution in twenty-four hours.

20 4. Device according to claim 3, characterized in that the first and second detection means (46a, 46b) are arranged such that the order in which they are actuated by the actuating means (70, 72) for the wheel (68) driven by the watch (1) movement is reversed depending upon whether the wheel (68) is rotating in the clockwise or anticlockwise direction.

25 5. Device according to claim 3, characterized in that the actuating wheel (68) is driven by an hour wheel (74) via an intermediate wheel (76).

6. Device according to claim 3, characterized in that once every twenty-four hours and for a determined period of time, the first and second

detection means (46a, 46b) are actuated simultaneously by the actuating means (70, 72) carried by the wheel (68) driven by the watch (1) movement.

7. Device according to claim 2, characterized in that the first and second detection means (46a, 46b) are formed by a wire spring.

5 8. Device according to claim 7, characterized in that the first and second detection means (46a, 46b) are wound and tightened.

9. Device according to claim 7, characterized in that the first and second detection means (46a, 46b) are V-shaped with first and second symmetrical arms (50a, 52a; 50b, 52b).

10 10. Device according to claim 8, characterized in that the first and second detection means (46a, 46b) are V-shaped with first and second symmetrical arms (50a, 52a; 50b, 52b).

11. Device according to claim 9, characterized in that the second arm (52a) of the first detection means (46a) and the second arm (52b) of
15 the second detection means (46b) form an angle of 60° between them.

12. Device according to claim 10, characterized in that the second arm (52a) of the first detection means (46a) and the second arm (52b) of the second detection means (46b) form an angle of 60° between them.

13. Device according to claim 8, characterized in that the first
20 detection means (46a) is carried by a first stud (26) which has a floating electrical potential, and in that the second detection means (46b) is carried by a second stud (56) which does not conduct electricity, the second detection means (46b) touching a third stud (30), which is brought to a floating electrical potential.

25 14. Device according to claim 2, characterized in that actuating wheel (68) is carried by a stud (28) which is connected to earth.

15. Device according to claim 14, characterized in that the actuating means (70, 72) carried by the actuating wheel (68) are formed by first and second pins which project underneath the bottom surface thereof.

16. Device according to claim 15, characterized in that the first and second pins (70, 72) carried by the actuating wheel (68) form an angle of 102° between them.

17. Device according to claims 15, characterized in that,
5 considering the watch from the bottom upwards, the actuating wheel (68) is arranged above the first and second detection means (46a, 46b).

18. Device according to claims 16, characterized in that, considering the watch from the bottom upwards, the actuating wheel (68) is arranged above the first and second detection means (46a, 46b).