

PATENT SPECIFICATION

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(54) AN ELECTRONIC WATCH

(71) We, THE UNITED STATES TIME CORPORATION, a Corporation organised under the Laws of the State of Connecticut, United States of America, of Waterbury 20, Connecticut, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to watches, and more particularly to electronic watches having an on-off switch.

Watches which utilize an electric battery as their source of power have become increasingly popular. They do not require winding and can be accurate timekeepers. Such watches are sold through retail outlets. It may be months, or even years, from the time they are manufactured until they are sold. If the watch were to run during that period, its battery would be worn down or exhausted by the time the watch was purchased.

In electric watches in which an electrical contact is opened and closed by the movement of a balance wheel, a mechanism is provided to ensure that the battery does not supply current during the time the watch is on the retailer's shelf. Usually the battery is switched out of the circuit by holding the balance wheel over to one side to keep the contacts open.

In "electronic" watches, transistors or other electronic devices are used to control battery current to one or more coils which interact with one or more magnets to provide movement of a mechanical oscillator. In electronic watches it is also important that a switch be provided so that the watch does not run when it is on the shelf and during the setting of the hands. The switching mechanism in electronic watches must be reliable. If it should fail when the watch is stopped, the wearer cannot again start the watch.

It is an objective of the present invention to provide a switching mechanism for an

electronic watch which controls the current from the battery, which mechanism is relatively simple, low in cost and reliable.

It is a further objective of the present invention to provide, in an electronic watch, a switch mechanism in the circuit of the watch, which mechanism is combined with the mechanism of the hand-setting stem.

In accordance with the present invention there is provided a watch comprising a watch case, a battery, an electronic circuit, a mechanical oscillator driven by the electronic circuit, a gear train driven by the mechanical oscillator, a setting staff which carries gears which are at all times in the gear train, a setting crown carried by the watch case and movable relative to the watch case and staff between a normal, inactive position and an active position for setting hands of the watch, a coupling disc which is movable with the setting crown and is adapted to couple the setting staff to the crown when the crown is moved into the setting position, a spring which acts on said coupling disc and normally urges said coupling disc towards its coupling position, and a contact carried by the spring and which normally makes electrical contact with a second contact to connect the battery to the circuit and is adapted to break said electrical contact when the crown is moved for the setting of the hands.

Reliability is often a function of the number of parts which constitute a mechanism; the more working parts, the more likely it is to fail. Consequently, it is desirable to combine the switch mechanism with the mechanism that physically holds the mechanical oscillator during hand setting. The hand-setting stem controls both switching and holding of the oscillator. The combination of functions results in greater reliability and lower cost, as comparatively fewer parts are utilized.

It is a preferred objective of the present invention to provide, in an electronic watch, a switch mechanism in the circuit of the watch, which mechanism is combined with

a mechanism to hold the mechanical oscillator during hand-setting.

A presently preferred electronic watch in accordance with the present invention has a case which encloses a battery, an electronic circuit and a mechanical oscillator such as a balance wheel. The mechanical oscillator is caused to oscillate by the interaction of one or more coils and one or more magnets. A hand-setting crown is positioned on the back of the case, i.e., on the case part which is adapted to be worn, in a wrist watch, next to the wrist of the wearer. The crown may be coupled, using a clutch-like mechanism, to a stem.

When the crown is pulled away from the case, it connects the crown to the stem which carries a gear in the gear train of the watch. The hand-setting mechanism also includes a spring having a normal and a hand-setting position. The spring is placed in its hand-setting position under the action of the setting crown. The spring has a detent arm which physically stops the movement of the mechanical oscillator and positions the oscillator during the setting of the hands. The spring carries an electrical contact which co-operates with a second spring contact to close or open the switch connecting the battery to its circuit. In its normal position, i.e., with the watch running, the contact on the spring is in electrical contact with the second spring, closing the circuit to the battery.

The crown, when pulled away from the case in its hand-setting position, enables the spring to hold the mechanical oscillator and at the same time breaks the electrical contact to the battery.

Other features of the present invention will be apparent from the detailed description of a preferred embodiment which follows, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side view, taken in cross-section, of a portion of the hand-setting device in a watch according to the present invention, the hand-setting device being in its normal position;

Fig. 2 is a side view, taken in cross-section, of the hand-setting device of Fig. 1 in its hand-setting position;

Fig. 3 is a partial top plan view of the spring of the device;

Fig. 4 is a circuit diagram showing the contact positions of the switch mechanism; and

Fig. 5 is a perspective view of the spring of Fig. 3 positioning a balance wheel.

Referring to the drawings, the electronic watch, not all parts of which are illustrated, includes a watch case having a dial, and rotating hands. The watch hands are driven by a gear train. The time base for the watch is provided by a mechanical oscillator, which

is preferably a balance wheel 120 (Fig. 5). The balance wheel 120 carries a coil which interacts with the flux fields of one or more fixed magnets which are attached to the frame plate of the watch. Alternatively, the coil may be fixed and the magnets may be attached to the balance wheel. The coil is pulsed with current at the time of its interaction with the magnets by means of an electronic circuit and a battery.

The portion of the watch mechanism shown in Fig. 1 includes a frame plate 10 which is adapted to be positioned within the watch case 44. A bridge 22 is spaced from the frame plate 10 by means of pillars (not shown). The gear train of the watch includes a minute wheel 30 which is fixed to a multi-purpose setting staff 32 (crown set wheel stem). The inner end of the multi-purpose staff 32 carries a minute pinion 34. The minute pinion 34 meshes with an hour wheel 35. The multi-purpose staff 32 has an inner bearing 37 in the frame plate 10 and has an outer bearing 38 in the bridge 22 so that the axis of the staff 32 is parallel to the axes of gears in the gear train. The outer portion of the multipurpose staff 32 is cut in the form of a coupling square 52 having four sides.

A watch setting crown 46 (crown set wheel) is accessible on the exterior of the watch case 44. The setting crown 46 includes an elongated tubular portion 47 forming an internal cavity. A retainer ring 45 is fixed to the watch case 44 and provides a bearing for the tubular portion 47 of the setting crown 46. A gasket 50, preferably of rubber, is positioned between the retainer ring 45 and the tubular portion 47 of the watch crown 46. The retainer ring 45, at its bottom edge, carries a lock-spring carrier 53 which consists of two annular rings. The annular rings of the lock-spring carrier 53 form a recess within which a lock spring 54 is positioned. The lock spring 54 co-operates with an outer lock spring recess 56 in the outer wall of the tubular portion 47 and also with an inner lock spring recess 57 of the tubular portion 47. The lock spring and its co-operating recesses 56 and 57 provide two positions, an inner position and an outer position, for the watch crown.

The watch crown, in its inner position, is in its normal position, i.e., with the watch running. The watch crown, in its outer position, is in its hand-setting position, i.e., the watch is not running. The tubular portion 47 of the setting crown 46 terminates in two follower fingers 51 and 55. The follower fingers 51 and 55 are adapted to be inserted within corresponding holes 58 and 59 in a coupling disc 60.

The coupling disc 60 (clutch disc) has an internal central hole 72 which is in the form of a square. The hole 72 is slightly

larger than the coupling square 52 and is adapted to be fit over the coupling square 52 when the watch crown is set in its outer or hand-setting position, Fig. 2. The turning of the crown with its follower fingers 51 and 55 will turn the coupling disc 60. The rotation of the coupling disc, in turn, will rotate the coupling square 52 and thereby rotate the multi-purpose staff 32. The rotation of the multi-purpose staff 32 turns the minute wheel 30 and the minute pinion 34 for the setting of the hands.

The coupling disc 60 is rotatable on top of a coupling spring 62 (setting spring). The coupling spring, as shown in Figs. 3 and 5, is attached, by means of its spring arm 64 and a screw 65, to the bridge 22. An arm 71 of the coupling spring 62 may be utilized as one of the battery contacts. The coupling spring 62 normally urges the disc 60 upward, that is, away from the bridge 22 and towards the case 44. The coupling spring 62 carries an electrical contact 101 which is in the form of a rivet having an upper rivet head 102. The bottom of contact 101, in the normal position shown in Fig. 1, is in contact with the upper raised arm portion 103b of a contact spring 103. The opposite end of contact spring 103, which is its portion 103a, is held between a bottom insulator block 105 and a top insulator block 104. The insulator block 105 has a cut-out portion 106 forming an insulative arm 105a. The arm 105a provides a stop to restrict the upward movement of the contact spring 103 when the crown is pulled out from the case, as shown in Fig. 2. Preferably the insulation 104 is the insulative base of the electronic circuit of the watch.

As shown in Fig. 4, the circuit has a lead 110 which is soldered to the contact spring 103. Lead 110 is connected, for example, to the positive contact of the battery. The circuit includes complementary transistors 111 and 112 and resistors 113, 114, 115 and 116. A complete explanation of the operation of the circuit of Fig. 4 will be found in United States Patent No. 3,046,460 to E. Zemla.

As shown in Figs. 3 and 5, the coupling spring 62 carries a detent member 70 (projection), of thin steel or other metal, which is connected to the spring 62 by the rivet contact 101 and a second rivet 121. The detent member 70 is positioned in the path of a stopping finger 122 on the balance wheel 120, when the setting crown 46 is pulled outwardly for the setting of the hands. The detent member 70 moves in a path about parallel to the axis of the balance wheel. The detent member 70 positions the balance wheel and prevents its movement.

It is thus seen that the coupling spring performs the following functions, under control of the setting crown: (1) it carries an

electrical contact to connect and disconnect the battery to the circuit, (2) it carries a detent which is placed in the path of a finger on the balance wheel to position the balance wheel and prevent its movement during the setting of the hands, and (3) it urges the coupling disc into engagement between the setting stem and the multi-purpose staff during the setting of the hands.

WHAT WE CLAIM IS:—

1. A watch comprising a watch case, a battery, an electronic circuit, a mechanical oscillator driven by the electronic circuit, a gear train driven by the mechanical oscillator, a setting staff which carries gears which are at all times in the gear train, a setting crown carried by the watch case and movable relative to the watch case and staff between a normal, inactive position and an active position for setting hands of the watch, a coupling disc which is movable with the setting crown and is adapted to couple the setting staff to the crown when the crown is moved into the setting position, a spring which acts on said coupling disc and normally urges said coupling disc towards its coupling position, and a contact carried by the spring and which normally makes electrical contact with a second contact to connect the battery to the circuit and is adapted to break said electrical contact when the crown is moved for the setting of the hands.

2. A watch as claimed in Claim 1, wherein the mechanical oscillator is a balance wheel and the spring also carries a detent member which positions the balance wheel during the setting of the hands.

3. A watch as claimed in Claim 1 or Claim 2, wherein the axis of the setting staff is parallel to the axes of the staffs carrying the other gears.

4. A watch as claimed in any one of the preceding claims, wherein the crown carries a finger which fits within a hole of the coupling disc during hand setting.

5. A watch as claimed in any one of the preceding claims, wherein the second contact is a spring arm mounted between insulation.

6. A watch as claimed in Claim 5, wherein the movement of the spring arm is limited by a portion of the insulation.

7. A watch substantially as hereinbefore described with reference to the accompanying drawings.

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larger than the coupling square 52 and is adapted to be fit over the coupling square 52 when the watch crown is set in its outer or hand-setting position, Fig. 2. The turning of the crown with its follower fingers 51 and 55 will turn the coupling disc 60. The rotation of the coupling disc, in turn, will rotate the coupling square 52 and thereby rotate the multi-purpose staff 32. The rotation of the multi-purpose staff 32 turns the minute wheel 30 and the minute pinion 34 for the setting of the hands.

The coupling disc 60 is rotatable on top of a coupling spring 62 (setting spring). The coupling spring, as shown in Figs. 3 and 5, is attached, by means of its spring arm 64 and a screw 65, to the bridge 22. An arm 71 of the coupling spring 62 may be utilized as one of the battery contacts. The coupling spring 62 normally urges the disc 60 upward, that is, away from the bridge 22 and towards the case 44. The coupling spring 62 carries an electrical contact 101 which is in the form of a rivet having an upper rivet head 102. The bottom of contact 101, in the normal position shown in Fig. 1, is in contact with the upper raised arm portion 103b of a contact spring 103. The opposite end of contact spring 103, which is its portion 103a, is held between a bottom insulator block 105 and a top insulator block 104. The insulator block 105 has a cut-out portion 106 forming an insulative arm 105a. The arm 105a provides a stop to restrict the upward movement of the contact spring 103 when the crown is pulled out from the case, as shown in Fig. 2. Preferably the insulation 104 is the insulative base of the electronic circuit of the watch.

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4. A watch as claimed in any one of the preceding claims, wherein the crown carries a finger which fits within a hole of the coupling disc during hand setting.

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