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## PATENT SPECIFICATION

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## (54) SOLID STATE WATCH ELECTRICAL SWITCH

(71) We, TIMEX CORPORATION, a Corporation organized under the Laws of the State of Delaware, United States of America of Waterbury, Connecticut 06720, 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 a case and an electrical switch for a solid state digital watch.

One of the main problems encountered by the prior art in solid state digital watches is the provision of means to set and reset the watch. A typical switch arrangement for accomplishing such operations is disclosed in our copending Application No. 1631/75 (Serial No 1461541). Preferably, the switch arrangement would involve a single stem and a minimum of associated parts. In a number of prior art designs, however, it has been necessary to provide at least two stem arrangements in order to obtain the necessary flexibility in setting the watch.

Accordingly, an object of this invention is to provide an improved case and switch for a watch.

Another object of this invention is to provide an improved detent arrangement for a solid state digital watch which also provides reliable electrical connection between the stem and detent and between the detent and case.

A further object of this invention is to provide an improved single stem for setting, resetting, and shutting down a solid state digital watch.

A more specific object of this invention is to provide an improved case and switch for a solid state digital watch which includes a stem and detent in a rather advantageous and economical design.

In contrast to the prior art, the present invention provides a relatively simple and inexpensive arrangement which fulfills the necessary watch functions with a single stem

and provides a rotary detent action with reliable electrical connection between the stem and the case. The stem shaft includes a rectangular section which co-operates with a spring for detenting and axial biasing purposes while a tab portion on one end of the shaft selectively engages switch blades.

According to the present invention there is provided the combination of a case for a solid state digital watch and an electric switch for a watch circuit mountable inside the case, and which comprises a stem comprising a rotatable elongated shaft having an eccentric tab projecting from one end thereof in the interior of the case, an intermediate rectangular section and an end portion which projects outwardly from the case, a plurality of switch blades mounted for selective engagement with the eccentric tab upon rotation of the shaft to provide predetermined setting functions for the watch in co-operation with the watch circuit, and a spring member engaging the rectangular section to provide a detent and having a base portion biased against the case to provide electrical contact therewith.

A preferred embodiment of the present invention includes a stem having a knurled knob or crown mounted on the end thereof protruding from the case and an elongated cylindrical shaft portion having an intermediate rectangular section of lesser diameter than the portion immediately inside the case and an eccentric tab at the end thereof inside the case.

The rectangular section engages a unitary stamped spring having two shaped arm portions engaging opposite sides of the rectangular section. The stem is locked axially in one of four positions by the co-operating action of the spring arms and the rectangular section which is smaller than the diameter of the shaft portion. The spring also includes a base portion which is biased against the case so that this preformed arrangement provides high simultaneous contact pressure between both the stem and detent and between the detent and case.

Good electrical connection is further enhanced by the wiping action of the stem when rotated.

As a further preferred feature, the eccentric tab on the end of the stem is designed to engage one of three switch blades. Two of the blades are positioned on opposite sides of the shaft and the third blade is positioned intermediate the opposing blades and in a plane below said blades. This arrangement permits setting and resetting the watch or shutting down the watch in a unique and expeditious manner by merely rotating the single stem to control the watch circuit.

Other features and advantages of this invention may be seen more clearly from the following description taken in conjunction with the accompanying drawings wherein:

Figure 1 is a perspective view showing a switch and a portion of a watch case according to the invention in a solid state watch, only part of which is illustrated;

Figure 2 is a view taken along the line 2—2 in Figure 1;

Figure 3 is a plan view showing a portion of the stem co-operating with the spring member in the vicinity of the watch case;

Figure 4 is a view taken along the line 4—4 in Figure 3 showing the detent contact pressure;

Figure 5 is a view taken along the line 5—5 in Figure 4 and,

Figure 6 is a view similar to Figure 5 but showing the stem in a rotated position.

Referring now to the drawings, a watch stem 10 includes an eccentric tab 11 at an inner end, a main shaft portion 12, an intermediate rectangular section 13 of lesser dimensions than the shaft 12, and an opposite end portion 14 projecting outwardly of the watch case or bezel 17 and having a watch crown 16 affixed thereto outside the watch case or bezel 17. As may be seen from Figure 1, the eccentric tab 11 co-operates with cantilevered switch blades 18 and 19 and 21 to effect an electrical connection with predetermined portions of the watch circuit.

The switch blades 18, 19 and 21 are thin beryllium copper stampings riveted or soldered to a substrate 22 at points 23 and 24 and 26 respectively. Switch blades 18 and 21 are mounted opposite each other spaced apart in the same plane and the blade 19 is mounted in the space between the opposed blades 18 and 21 and in a plane parallel to the plane of the blades 18 and 21.

The switch blade 18 is connected to an integrated circuit chip (not shown) through a printed circuit lead 27. Printed circuit leads 28 and 29 similarly connect switch blades 19 and 21 to the aforementioned chip which is located within a plastics dam 31. A plurality of contact terminals 32 and their respective

leads 33 are shown in Figure 1; these are not pertinent to the present invention and for further details reference may be made to our co-pending Application No. 1631/75. (Serial No 1461541).

The switch blade 18 which is engaged by the tab 11 when the stem 10 is turned in that particular direction is designated as the setting switch blade and is coupled to logic circuits (not shown) to provide a capability of selectively advancing the minutes or hours counters at 1 Hz rate and/or to reset the seconds counters to zero. Switch blade 21 is characterized as the mode switch blade. Switch blade 19 is engaged by tab 11 when it is desired to shut down the watch.

The stem 10 also permits detent holding of the stem in a proper contact position and provides electrical contact to ground the stem to the case. This is effected through the rectangular section 13 which is smaller than the diameter of the shaft portion 12. The rectangular section 13 engages a single stamped spring 34 to provide a four position rotary detent action. The spring 34 comprises a pair of spaced, substantially U-shaped arms 39 and 41 extending upwardly from a preformed base 36 of the spring 34. The opposing legs 37 and 38 of the spring arms 39 and 41 are spring biased into engagement with the rectangular section 13. As can be noted from the drawings, particularly Figures 3 to 6, the spring 34 is preformed so as to exert a high simultaneous radial contact pressure between the stem section 13 and the legs 37 and 38 and axial contact pressure between the base 36 of spring 34 and the case 17 thus providing a good electrical connection between stem 10 and case 17 which is further enhanced by the wiping action of the stem when rotated.

Figure 5 shows the rectangular section 13 of the stem 10 and particularly corners 42 and 43 thereof in contact with the legs 38 and 37 of spring 34. It is to be noted that the distance across the corners of the rectangular section 13 is smaller than the shaft diameter in order to provide a shoulder for the arms 39 and 41 to bias the stem axially regardless of its rotational position. The stem is prevented from moving axially inward by the crown 16 against bezel 17, thus creating good contact pressure between spring base 36 and case 17.

#### WHAT WE CLAIM IS:—

1. The combination of a case for a solid state digital watch and an electric switch for a watch circuit mountable inside the case, and which comprises a stem comprising a rotatable elongated shaft having an eccentric tab projecting from one end thereof in the interior of the case, an intermediate rectangular section and an end portion which projects outwardly from the case, a plurality of switch blades mounted for

Good electrical connection is further enhanced by the wiping action of the stem when rotated.

As a further preferred feature, the eccentric tab on the end of the stem is designed to engage one of three switch blades. Two of the blades are positioned on opposite sides of the shaft and the third blade is positioned intermediate the opposing blades and in a plane below said blades. This arrangement permits setting and resetting the watch or shutting down the watch in a unique and expeditious manner by merely rotating the single stem to control the watch circuit.

Other features and advantages of this invention may be seen more clearly from the following description taken in conjunction with the accompanying drawings wherein:

Figure 1 is a perspective view showing a switch and a portion of a watch case according to the invention in a solid state watch only part of which is illustrated;

Figure 2 is a view taken along the line 2—2 in Figure 1;

Figure 3 is a plan view showing a portion of the stem co-operating with the spring member in the vicinity of the watch case;

Figure 4 is a view taken along the line 4—4 in Figure 3 showing the detent contact pressure;

Figure 5 is a view taken along the line 5—5 in Figure 4 and,

Figure 6 is a view similar to Figure 5 but showing the stem in a rotated position.

Referring now to the drawings, a watch stem 10 includes an eccentric tab 11 at an inner end, a main shaft portion 12, an intermediate rectangular section 13 of lesser dimensions than the shaft 12, and an opposite end portion 14 projecting outwardly of the watch case or bezel 17 and having a watch crown 16 affixed thereto outside the watch case or bezel 17. As may be seen from Figure 1, the eccentric tab 11 co-operates with cantilevered switch blades 18 and 19 and 21 to effect an electrical connection with predetermined portions of the watch circuit.

The switch blades 18, 19 and 21 are thin beryllium copper stampings riveted or soldered to a substrate 22 at points 23 and 24 and 26 respectively. Switch blades 18 and 21 are mounted opposite each other spaced apart in the same plane and the blade 19 is mounted in the space between the opposed blades 18 and 21 and in a plane parallel to the plane of the blades 18 and 21.

The switch blade 18 is connected to an integrated circuit chip (not shown) through a printed circuit lead 27. Printed circuit leads 28 and 29 similarly connect switch blades 19 and 21 to the aforementioned chip which is located within a plastics dam 31. A plurality of contact terminals 32 and their respective

leads 33 are shown in Figure 1; these are not pertinent to the present invention and for further details reference may be made to our co-pending Application No. 1631/75. (Serial No 1461541).

The switch blade 18 which is engaged by the tab 11 when the stem 10 is turned in that particular direction is designated as the setting switch blade and is coupled to logic circuits (not shown) to provide a capability of selectively advancing the minutes or hours counters at 1 Hz rate and/or to reset the seconds counters to zero. Switch blade 21 is characterized as the mode switch blade. Switch blade 19 is engaged by tab 11 when it is desired to shut down the watch.

The stem 10 also permits detent holding of the stem in a proper contact position and provides electrical contact to ground the stem to the case. This is effected through the rectangular section 13 which is smaller than the diameter of the shaft portion 12. The rectangular section 13 engages a single stamped spring 34 to provide a four position rotary detent action. The spring 34 comprises a pair of spaced, substantially U-shaped arms 39 and 41 extending upwardly from a preformed base 36 of the spring 34. The opposing legs 37 and 38 of the spring arms 39 and 41 are spring biased into engagement with the rectangular section 13. As can be noted from the drawings, particularly Figures 3 to 6, the spring 34 is preformed so as to exert a high simultaneous radial contact pressure between the stem section 13 and the legs 37 and 38 and axial contact pressure between the base 36 of spring 34 and the case 17 thus providing a good electrical connection between stem 10 and case 17 which is further enhanced by the wiping action of the stem when rotated.

Figure 5 shows the rectangular section 13 of the stem 10 and particularly corners 42 and 43 thereof in contact with the legs 38 and 37 of spring 34. It is to be noted that the distance across the corners of the rectangular section 13 is smaller than the shaft diameter in order to provide a shoulder for the arms 39 and 41 to bias the stem axially regardless of its rotational position. The stem is prevented from moving axially inward by the crown 16 against bezel 17, thus creating good contact pressure between spring base 36 and case 17.

#### WHAT WE CLAIM IS:—

1. The combination of a case for a solid state digital watch and an electric switch for a watch circuit mountable inside the case, and which comprises a stem comprising a rotatable elongated shaft having an eccentric tab projecting from one end thereof in the interior of the case, an intermediate rectangular section and an end portion which projects outwardly from the case, a plurality of switch blades mounted for



selective engagement with the eccentric tab upon rotation of the shaft to provide predetermined setting functions for the watch in co-operation with the watch circuit, and a spring member engaging the rectangular section to provide a detent and having a base portion biased against the case to provide electrical contact therewith.

2. The combination in accordance with Claim 1, wherein the plurality of switch blades comprise a pair of spaced apart cantilevered blades mounted opposite each other in the same plane and third cantilevered blade mounted in the space between the opposed blades and in a plane parallel to the plane of the said pair of blades.

3. The combination in accordance with Claim 1 or Claim 2, wherein the dimensions of the rectangular section are less than the diameter of the shaft to provide a shoulder for engagement by the spring member to enable the spring member to bias the stem axially regardless of its rotational position.

4. The combination in accordance with any one of the preceding claims wherein the spring member comprises an elongated base portion engaged with the watch case, and a pair of juxtaposed protruding substantially U-shaped arms extending therefrom with the juxtaposed arms being free at the ends

thereof to exert radial locking pressure on the rectangular section of the shaft which is located therebetween and to exert axial biasing of the stem.

5. The combination in accordance with any one of the preceding claims wherein, the rectangular section co-operates with the spring member to provide four rotational positions of detenting action.

6. The combination in accordance with any of the preceding claims wherein the switch blades comprise thin beryllium copper stampings.

7. The combination in accordance with any one of the preceding claims, wherein the end portion of the shaft which projects outwardly from the case includes a crown mounted thereon.

8. The combination of a case for a solid state digital watch and an electric switch for a watch circuit mountable inside the case, substantially as hereinbefore described with reference to the accompanying drawings.

9. A solid state digital watch incorporating the case and switch as claimed in any one of the preceding claims.

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