A solid state digital watch comprises a stem detent and switch assembly which includes a crown portion on the outside of the watch case and a shaft portion extending therethrough. The shaft portion includes an intermediate rectangular section on the inside of the case which cooperates with a single stamped spring to provide a four position rotary detent action.

In addition to permitting detent holding of the stem in the proper contact position, this arrangement also provides electrical contact to ground the stem to the case. The internal end of the shaft includes an eccentric tab which contacts one of three precisely positioned blades when the stem is rotated to advance the minutes or hours counters, to reset the seconds counter or to shut down the watch.

7 Claims, 6 Drawing Figures
3,874,162

SOLID STATE WATCH STEM DETENT AND SWITCH ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to solid state watches and particularly to a stem detent and switch assembly for solid state digital watches.

One of the main problems encountered by the prior art in solid digital watches is the provision of means to set and reset the watch. A typical switch arrangement for accomplishing such operations is disclosed in the pending application, Ser. No. 462,151, filed Apr. 18, 1974, by the present inventors. 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.

In the digital watch of U.S. Pat. No. 3,756,011 to Nishimura et al., filed Sept. 7, 1972, the correction of each display element is achieved through the use of a single winding crown. A square portion of the crown is coupled to the mating aperture of a wiper element which engages one of a plurality of fixed contacts in order to set and reset the watch. The end portion of the crown also comprises a switch which opens or closes the circuit when the crown is moved axially.

In further prior art references, U.S. Pat. No. 3,733,803 to Hiraga, et al., issued May 22, 1973, discloses a rotary switch which permits adjustment in the time of an electronic watch and which includes a projection engaging a particular printed board contact structure. U.S. Pat. No. 3,659,067 to Wilkinson, issued Apr. 27, 1972 discloses a U-shaped spring detent but the surface of the spigot is different from the surface of the cutaway shaft of the present invention and the camming surface of Wilkinson's member 18 has a cutaway V-shaped section differing from the straight section of the present invention.

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 assembly and provides a four position rotary detent action with reliable electrical connection between the stem and the case. The stem shaft of the invention includes a rectangular section which cooperates with a peculiarly shaped spring for detenting and axial biasing purposes while a tab portion on the internal end of the shaft selectively engages spaced watch blades.


SUMMARY OF THE INVENTION

The present invention relates to a stem assembly for solid state digital watches which comprises a stem having a shaft portion with a knurled knob or crown mounted on the end thereof protruding from the bezel and an elongated cylindrical shaft portion having an intermediate rectangular section of lesser diameter in the portion immediately inside the bezel and an eccentric tab at the internal end thereof.

The rectangular portion engages a unitary stamped spring having two spaced arm portions engaging opposite sides of the rectangular section. The stem is locked axially in one of four positions by the cooperating action of the spring arms and the rectangular section which is smaller than the diameter of the shaft portion. The spring also includes outwardly extending base portions at each end which are 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. In the embodiment described above, good electrical connection is further enhanced by the wiping action of the stem when rotated.

As a further 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.

Accordingly, an object of this invention is to provide a new and improved stem assembly for a solid state digital watch.

Another object of this invention is to provide a new and 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 a new and improved single stem assembly means for setting, resetting, and shutting down a solid state digital watch.

A more specific object of this invention is to provide a new and improved stem assembly for a solid state digital watch which includes a multi-position stem detent arrangement and an internal switch arrangement in a rather advantageous and economical design.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a perspective view showing the stem assembly and cooperating portions of the solid state watch,

FIG. 2 is a view taken along the lines of 2—2 of FIG. 1,

FIG. 3 is a plan view showing a portion of the stem assembly cooperating with the spring member in the vicinity of the watch case,

FIG. 4 is a view taken along the line 4—4 of FIG. 3 showing the detent contact pressure,

FIG. 5 is a view taken along the line 5—5 of FIG. 4, and,

FIG. 6 is a view similar to FIG. 5 showing the stem and particularly the rectangular portion under rotation.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, the invention comprises a solid state watch stem assembly 10 which includes an eccentric tab 11 at one end, a main shaft portion 12, an intermediate rectangular section 13 of lesser diameter than the shaft 12, and another end por-
tion 14 having the watch crown 16 affixed thereto outside the case or bezel 17. As may be seen from FIG. 1, the eccentric tab 11 cooperates with the 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 the substrate 22 at points 23 and 24 and 26 respectively. The switch blade 18 is connected to an integrated circuit chip (not shown) through printed circuit leads 27. Printed circuit leads 28 and 29 similarly connect switch blades 19 and 21 to the aforementioned chip which is located within the plastic dam 31. A plurality of contact terminals 32 and their respective leads 33 are shown in FIG. 1 but since they are not pertinent to the present invention, reference must be made to the co-pending application of the inventor's Ser. No. 462,151 filed Apr. 18, 1974.

The switch blade 18 which is engaged by the tab 11 when the stem assembly 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 off selectively advancing the minutes or hours counters at 1Hz rate and/or to reset the seconds counters to zero by manipulation of switch blades 18 and 21.

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 assembly 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 portion 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 extending upwardly from the preformed base 36 of the spring 34. The opposing legs 37 and 38 of the protruding contact members 39 and 41 are spring biased into engagement with the rectangular section 13. As can be noted from the drawings, particularly FIGS. 3-6, the spring 34 is preformed so as to exert a high simultaneous radial contact pressure between the stem portion 13 and the arms 37 and 38 and axial contact pressure between the base 36 of spring 34 and the case 17. This electrical connection is further enhanced by the wiping action of the stem when rotated.

FIG. 5 shows the rectangular section 13 of the stem 10 and particularly edges 41 and 42 thereof in contact with the arms 38 and 37 with corner portions 43 and 44. It is to be noted that the distance across the corners of the rectangular portion 13 is smaller than the shaft diameter in order to provide a shoulder for the arms 38 and 37 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.

While the invention has been explained by a detailed description of certain embodiments, it is understood that various modifications and substitutions can be made in any of them within the scope of the appended claims which are intended also to include equivalents of such embodiments.

What is claimed is:

1. A stem detent and switch assembly for a solid state digital watch with a circuit inside a case which comprises:
   an elongated shaft, an eccentric tab at the interior end thereof, an intermediate rectangular section and an end portion projecting outwardly from the case,
   a plurality of switch blades mounted for selective engagement with the eccentric tab to provide predetermined setting functions for the watch in cooperation with the watch circuit and,
   a spring member engaging the rectangular section to provide a detent action and having a base portion biased against the case to provide electrical contact therewith.

2. A stem detent and switch assembly for a solid state digital watch 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 a third cantilever blade mounted in the space between the opposed blades and in a plane parallel to the plane of the first two blades.

3. A stem detent and switch assembly for a solid state digital watch in accordance with claim 1 wherein:
   the diameter of the rectangular section is less than the diameter of the shaft portion to provide a shoulder for engagement by the spring member to bias the stem axially regardless of its rotational position during detenting

4. A stem detent and switch assembly for a solid state digital watch in accordance with claim 1 wherein:
   the cooperating spring member comprises an elongated base portion in biased engagement with the watch case, and, a pair of 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 therebetwen and to exert axial biasing of the stem.

5. A stem detent and switch assembly for a solid state digital watch in accordance with claim 1 wherein:
   the rectangular section cooperates with the spring to provide a four position rotary detent action.

6. A stem detent and switch assembly for a solid state digital watch in accordance with claim 1 wherein:
   the switch blades comprise thin beryllium copper stampings.

7. A stem detent and switch assembly for a solid state digital watch in accordance with claim 1 wherein:
   the end portion of the shaft projecting outwardly from the case includes a crown mounted thereon, and,
   the cantilevered switch blades are connected at one end thereof to the solid state circuit of the watch.

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