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(54) IMPROVEMENTS IN CONTACT SPRINGS IN ELECTRO-MECHANICAL TIMEKEEPERS

(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:—

This invention relates generally to electro-mechanical horological devices of the type having an oscillating balance member and impulse means, such as a miniature electric coil and magnet system, actuated when a contact spring strikes a contact pin mounted on the balance member, to drive the member in oscillation.

The simplest type of contact spring is a flat spring which is wiped in alternate directions by an electrically conductive pin on the balance wheel. However, a flat spring does not provide the best electrical contact or a self-cleaning action. Another type of contact spring is a round cross-section spring wire which provides good cleaning action, but which is stiff and interferes with proper operation of the balance wheel. Other constructions have been suggested in the prior art for forming the end or controlling the contact area at the end of the contact spring, but these tend to be expensive due to the extremely small dimensions of the contact spring which is, for example, of the order of 7½ millimeters long, .15 millimeters wide and .025 millimeters thick.

Accordingly, one object of the present invention is to provide an electro-mechanical watch having a contact spring of improved construction and which is inexpensive and flexible while providing proper electrical contact and self-cleaning action.

Another object of the invention is to provide a less expensive and more effective construction of a contact spring in an electric watch.

According to the invention there is provided an electro-mechanical timekeeping device including an oscillating balance mem-

ber with an electric contact pin thereon, a contact spring mounted adjacent the balance member and disposed to strike the contact pin during oscillation of said balance member thereby completing an electrical circuit to actuate impulse means driving said balance member in oscillation, said contact spring comprising a straight spring member having a flat flexing portion oriented normal to the plane of oscillation of said balance member and a straight contact end portion, said end portion being deformed symmetrically so as to provide on opposite sides thereof identical rigid flat or rounded contact surfaces for contacting said pin.

The end portion of the contact spring is preferably crimped on both sides in a symmetrical manner into an S-shaped cross-section or is twisted 90 degrees to present alternate edge surfaces to the balance wheel contact pin.

The above and other features and advantages of the present invention will become further apparent from the following description of two preferred embodiments, reference being had to the accompanying drawings wherein:—

Fig. 1 is a schematic representation of part of a balance member, coil and associated electrical circuitry including a contact spring, according to one embodiment of the invention;

Fig. 2 is an enlarged perspective view of the end of the spring of Fig. 1, and the contact pin;

Fig. 3 is an enlarged perspective view, similar to Fig. 2, of a second form of contact spring and

Figs. 4a to 4e are comparative perspective views of prior art constructions of contact springs.

Referring now to Figure 1 of the drawings, there is shown schematically part of the driving system of an electro-mechanical watch, such details of which as are not illustrated being conventional. As shown, a balance wheel member 1 is mounted for oscillatory movement on a staff 2 with an electrically conductive spiral hairspring 3 for returning

the balance member after it has been given an impulse by an electric coil 4 coacting with a permanent magnet system (not shown). One end of the coil is connected to the hairspring 3 which, in turn, is connected to a battery 5. The other end of the coil 4 is connected to an electrically conductive balance pin 6 for making repetitive wiping contact with a contact spring 7 which is the subject of the present invention. Although not material to the present invention, the spring member may include a mechanical damping construction 8, and the electrical impulses may be synchronized by means of an electrically controlled switch 9 which is controlled by an integrated circuit and quartz oscillator (not shown). The synchronizing arrangement may operate in the manner of United States Patent Specification No. 3,699,762, while the assembly for holding the contact spring may be as disclosed in United States Patent Specification No. 3,698,179. The driving system shown is illustrative of the general type in which the present invention is intended to be utilized.

In accordance with the present invention, the contact spring 7 is a simple flat spring strip member disposed with its flat flexing portion 10 normal to the plane of oscillation of the balance wheel 1 for maximum flexibility and minimum interference with the balance wheel action in a manner as such well known in the art. The end portion 11 of contact spring 7 is crimped symmetrically to form a S-shaped or sinusoidal cross-section. Depending upon the crimping tool, it could also take on a Z-shaped appearance.

Fig. 2 is an enlarged perspective view of end portion 11 of the contact spring 7 of Figure 1. The crimping tool used in manufacture of the spring has provided an S-shaped configuration with one crown 12 arranged to present a rigid surface of minimum contact area to the balance pin 6 on one side of the spring and an identical crown 13 on the other side of the spring for the return swing of the balance member 1 and pin 6. Rigidity is provided by the S-shaped cross-section, and optimum electrical contact with consequent self-cleaning action is provided by the crown contact surfaces 12 and 13.

Referring to Fig. 3 of the drawings, an alternative construction of contact spring employs a straight end portion 14 which is twisted 90° from the flexing portion 10 of the spring. In this manner, the edges 15 and 16 are brushed alternately by pin 6 providing a rigid minimum surface contact area for optimum electrical contact and self-cleaning action.

Some examples of prior art constructions are shown in Figs. 4a to 4e for purposes of comparison. The constructions of Figs. 4a

and 4b with U-shaped double ends of arcuate cross-section are operationally good, but expensive to manufacture. The construction of Fig. 4c offers manufacturing difficulties as well. The construction of Fig. 4d which has an end twisted at a small angle is partially successful, but soon wears the pin on opposite sides as indicated at 17, 18 and causes undesirable vertical movements. The construction of Fig. 4e provides a spring which is too stiff.

The present construction provides a very simple solution by means of a simple crimping or twisting operation on the end of the flat spring without requiring blanking or elaborate forming tools. Identical wearing surfaces are presented to the balance wheel pin with small surface area for good electrical contact and self-cleaning action over the millions of electrical contacts which the contact spring must make during its expected operating life.

WHAT WE CLAIM IS:—

1. An electro-mechanical timekeeping device including an oscillating balance member with an electric contact pin thereon, a contact spring mounted adjacent the balance member and disposed to strike the contact pin during oscillation of said balance member thereby completing an electrical circuit to actuate impulse means driving said balance member in oscillation, said contact spring comprising a straight spring member having a flat flexing portion oriented normal to the plane of oscillation of said balance member and a straight contact end portion, said end portion being deformed symmetrically so as to provide on opposite sides thereof identical rigid flat or rounded contact surfaces for contacting said pin.
2. A timekeeping device according to Claim 1, wherein said end portion is crimped to provide an S-shaped cross-section with opposite crowns of the S providing said contact surfaces.
3. A timekeeping device according to Claim 1, wherein said end portion is rotated 90° with respect to the flat flexing portion whereby said opposite contact surfaces are provided by the opposite edges of the spring member.
4. An electro-mechanical timekeeping device including a contact spring substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

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the balance member after it has been given an impulse by an electric coil 4 coacting with a permanent magnet system (not shown). One end of the coil is connected to the hairspring 3 which, in turn, is connected to a battery 5. The other end of the coil 4 is connected to an electrically conductive balance pin 6 for making repetitive wiping contact with a contact spring 7 which is the subject of the present invention. Although not material to the present invention, the spring member may include a mechanical damping construction 8, and the electrical impulses may be synchronized by means of an electrically controlled switch 9 which is controlled by an integrated circuit and quartz oscillator (not shown). The synchronizing arrangement may operate in the manner of United States Patent Specification No. 3,699,762, while the assembly for holding the contact spring may be as disclosed in United States Patent Specification No. 3,698,179. The driving system shown is illustrative of the general type in which the present invention is intended to be utilized.

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