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(54) ELECTRONIC TIMEPIECE

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese body corporate, of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, 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 to electronic timepieces and in particular, although not so restricted, to electronic wrist watches.

The present invention seeks to provide an electronic timepiece of the type with a digital display device and oscillator means for producing a time standard signal, wherein the time indication can be corrected without stopping the timepiece.

In a conventional electric wrist watch using mechanical time indicators such as hands to correct the seconds time indication the wrist watch is stopped with the seconds hand indicating a desired time until the correct time reaches the desired time when the wrist watch is restarted. Consequently, a switch must be operated at least twice and there is a necessity of waiting for the correct time to reach the desired time and these factors make correction of the time indication in the conventional wrist watch troublesome.

According to the present invention there is provided an electronic timepiece having oscillator means for producing a time standard signal, a divider and distributor circuit for producing therefrom a time signal, a digital display device for displaying a time indication from the time signal, time setting means for setting the hours and minutes of the time indication, and time correcting means arranged to control said divider and distributor circuit to reset to zero only a seconds indication of the time indication the arrangement being such that after the seconds indication has been reset to zero, counting and indication of seconds continues automatically from zero.

Preferably the divider and distributor circuit is such that if the seconds indication is between 0 and 30 operation of the correcting means resets the seconds indication to zero without affecting a minutes indication of the time indication, but if the seconds indication is between 30 and 60 operation of the correcting means resets the seconds indication to zero and increases the minutes indication by unity.

Preferably the oscillator means is a quartz crystal oscillator.

In the preferred embodiment the setting means and the correcting means are switches.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:—

Figure 1 is a block diagram of an electronic wrist watch according to the present invention;

Figure 2 is a plan view of an electronic wrist watch according to the present invention;

Figures 3 and 4 illustrate correction of the time indication of a wrist watch according to the present invention;

Figure 5 is a block diagram in greater detail of part of the electronic wrist watch of Figure 1; and

Figure 6 illustrates the waveforms at various points in the circuit shown in Figure 5.

Referring to the drawings, and in particular to Figure 1, there is shown a block diagram of an electronic wrist watch according to the present invention. An oscillator 1, for example a quartz crystal oscillator, produces a time standard signal which is fed to an electronic divider and distributor circuit 2 which produces a time signal which is received by a digital display device

3 to display a time indication therefrom. The digital display device 3 may employ liquid crystal elements, light emitting diodes, etc. The time indication displayed by the digital display device may be set or corrected by means of a setting and correcting circuit 4 which operates upon the divider and distributor circuit 2.

Figure 2 is a plan view of an electronic wrist watch according to the present invention having a digital display device 5 which may be similar to the digital display device 3 of the electronic wrist watch of Figure 1, an hour setting switch 6, a minutes setting switch 7 and a correcting switch 8, these switches forming a setting and correcting circuit.

The setting switch 7 is used to set the minutes indication of the digital display device and the setting switch 6 is used to set the hours indication of the digital display device. The setting switches 6, 7 therefore, may be used to set a desired time indication, for example, when the wrist watch has been stopped when a battery (not shown) thereof is replaced.

The correcting switch 8 is operated to reset to zero only the seconds indication of the time indication of the wrist watch. The types of correction that can be effected are illustrated in Figures 3 and 4. A wrist watch which uses a quartz crystal oscillator to produce a time standard signal is so accurate that the time indication is unlikely to vary from the correct time over the course of a month by more than 30 seconds. It is, therefore, sufficient if a correction of up to $\pm$ 30 seconds can be made to the time indication. Referring to Figure 3, the time indication before correction is 10 hrs. 59 mins. and 25 secs. and is 25 seconds in advance of the correct time. The correcting switch 8 is operated simultaneously with an announcement of the correct time, for example, given over the radio or television, when the time indication is substantially instantaneously corrected to 10 hrs. 59 mins. and 0 secs. to be in line with the correct time.

Referring to Figure 4 the time indication before correction is 10 hrs. 59 mins. and 37 secs. being 23 seconds behind the correct time. The correcting switch 8 is operated again simultaneously with an announcement of the correct time and the time indication is substantially instantaneously corrected to 11 hrs. 0 mins. 0 secs. Thus correction of the time indication can be performed quite readily merely by operating the correcting switch 8. This causes the seconds indication to be reset to zero, after which counting and indication of seconds continues automatically from zero.

Figure 5 shows in greater detail a divider and distributor circuit 2 and the setting and correcting circuit 4 of Figure 1. An input 28 receives the time standard signal from the oscillator 1 and supplies the time standard signal to a divider circuit 9 the output of which is a seconds signal (i.e. a signal having a frequency of 1 Hz). Subsequent divider circuits 10, 11, 12 divide the seconds signal by 10, 3 and 2 respectively to produce at the output 26 of the divider circuit 12 a minutes signal (i.e. a signal having a frequency of 1/60 Hz). Subsequent divider circuits 13, 14 divide the minutes signal by 10 and 6 respectively to produce at the output of the divider circuit 14 an hour signal (i.e. a signal having a frequency of 1/3600 Hz). A divider circuit 15 divides the hour signal by 12 to produce a half-day signal (i.e. a signal having a frequency of 1/43,200 Hz). Distributor circuits 16, 17, 18 distribute the outputs of the above mentioned divider circuits and supply them to the digital display device 3.

A time correcting switch 22 and time setting switches 23, 24 corresponding to the correcting switch 8 and the setting switches 7, 6, respectively of Figure 2 are provided. A reset signal from the correcting switch 22 is fed to a shaping circuit 19 which shapes its waveform. The reset signal is then fed to the divider circuit 9, 10, 11, 12 to reset their outputs to zero.

A control circuit 20 is in series between the divider circuit 12 and the divider circuit 13 to shape a time setting signal from the setting switch 23 and the minutes signal fom the divider circuit 12. A control circuit 21 is in series between the divider circuit 14 and the divider circuit 15 to shape a time setting signal from the setting switch 24 and the hours signal from the divider circuit 14.

Figure 6 shows the output waveforms (i), (ii) and (iii) of the output signals from the shaping circuit 19, the divider circuit 12 and the control circuit 20 respectively.

Referring to Figure 6 (ii) there is shown the two stable conditions of the minutes signal fed to the control circuit 20. The minutes signal changes from a first stable condition to a second stable condition every 30 seconds. Accordingly, even if a reset signal as shown in Figure 6 (i) is applied to the divider and distributor circuit 2 when the seconds indication of the digital display device is between 0 and 30 seconds, the output signal of the control circuit 20 is unaffected and consequently the minutes indication is unaltered although the seconds indication is reset to zero because the divider circuits 9, 10, 11, 12, which produce the seconds signal, are reset to zero during the short duration of the reset signal.

If the reset signal is applied to the

divider and distributor circuit when the seconds indication of the digital display device is between 30 and 60 seconds, the output signal of the control circuit 20 is affected as shown in Figure 6 (iii). Thus not only is the seconds indication reset to zero but also the minutes indication increases by unity becouse the minutes signal changes from the first stable condition to the second stable condition.

Thus correction of the time indication can be produced easily and the electronic wrist watch has a relatively low power consumption. The electronic wrist watch may be made of small size by using complementary metal oxide semiconductors in the circuits thereof.

WHAT WE CLAIM IS:—

1. An electronic timepiece having oscillator means for producing a time standard signal, a divider and distributor circuit for producing therefrom a time signal, a digital display device for displaying a time indication from the time signal, time setting means for setting the hours and minutes of the time indication, and time correcting means arranged to control said divider and distributor circuit to reset to zero only a seconds indication of the time indication, the arrangement being such that after the seconds indication has been reset to zero, counting and indication of seconds continues automatically from zero.

2. A timepiece as claimed in claim 1 in which the divider and distributor circuit is such that if the seconds indication is between 0 and 30 operation of the correcting means resets the seconds indication to zero without affecting a minutes indication of the time indication, but if the seconds indication is between 30 and 60 operation of the correcting means resets the seconds indication to zero and increases the minutes indication by unity.

3. A timepiece as claimed in claim 1 or 2 in which the oscillator means is a quartz crystal oscillator.

4. A timepiece as claimed in any preceding claim in which the setting means and the correcting means are switches.

5. An electronic timepiece substantially as herein described with reference to and as shown in the accompanying drawings.

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divider and distributor circuit when the seconds indication of the digital display device is between 30 and 60 seconds, the output signal of the control circuit 20 is affected as shown in Figure 6 (iii). Thus not only is the seconds indication reset to zero but also the minutes indication increases by unity becouse the minutes signal changes from the first stable condition to the second stable condition.

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