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PATENT SPECIFICATION

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(54) DIGITAL ELECTRONIC WATCH

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese Company of 31-1, 6-chome, Kameido, Koto-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 digital electronic watches.

According to the present invention there is provided a digital electronic watch comprising: a time display device; timekeeping means for producing an actual time of day indication for display by the display device; alarm time storing means; alarm setting means by which an alarm time may be set in the storing means, alarm means for producing a warning when the set alarm time and the actual time of day indication coincide; display illuminating means; and preventing means for preventing more than one of the alarm means and the illuminating means from being in an energised state at any time.

Preferably the preventing means is such that, in operation, if the alarm means is energised when the illuminating means is in an energised state, the latter is immediately de-energised.

The watch preferably includes coincidence means for energising the alarm means when the set alarm time and the actual time of day indication coincide.

The preventing means, in one embodiment, is a NOR circuit, one input of which is connected to receive a signal for energising the illuminating means and the other input of which is connected to receive a signal when the alarm means is energised.

In another embodiment the preventing means is a flip-flop circuit one output of which is connected to energise the alarm means and the other output of which is connected to energise the illuminating means.

Preferably the watch includes re-set

means for de-energising the alarm means after a predetermined time.

The watch may include switch means for manually de-energising the alarm means.

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

Figure 1 is a block diagram of a first embodiment of a digital electronic watch according to the present invention; and

Figure 2 is a block diagram of a second embodiment of a digital electronic watch according to the present invention.

Referring now to Figure 1 there is illustrated a first embodiment of a digital electronic watch according to the present invention having an oscillator circuit 1 for producing a standard time signal which is fed to a comparison and coincidence circuit 3 via a time keeping counter circuit 2. An alarm time setting circuit 4 produces an output signal which is fed to an alarm time counter circuit 5. An output signal from the alarm time counter circuit 5 is applied to the comparison and coincidence circuit 3. An output signal from the display switching circuit 6 is transmitted to an indicator or display device 8 through a decoder/driver circuit 7.

An output signal from the comparison and coincidence circuit 3 is fed to an alarm device 10 through a driver circuit 9 the output signal of which forms one input of a NOR circuit 11. The other input of the NOR circuit 11 is formed by an output signal of a driver circuit 13 fed via a controlling switch 12. The output signal of the NOR circuit 11 is connected to an illuminating device 14 to illuminate a display panel (not shown) of which the display device 8 may form a part.

The operation of the digital electronic watch of Figure 1 will be explained in detail hereinafter.

The standard time signal generated by the oscillator circuit 1 is counted by the timekeeping counter circuit 2 to produce an actual time of day indication signal. In

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the alarm time setting circuit 4, an alarm time, i.e. the time when an alarm is to be given, can be set and memorised in the alarm time counter circuit 5. When setting the alarm time the display switching circuit 6 transmits the contents of the alarm time counter circuit 5 to the display device 8 through the decoder/driver circuit 7 under the control of the alarm time setting circuit 4.

When the contents of the alarm time counter circuit 5 coincide with that of the timekeeping counter circuit 2, a coincidence signal from comparison and coincidence circuit 3 is transmitted to the driver circuit 9 which energises the alarm device 10.

When the controlling switch 12 is turned ON so that it is brought into contact with a terminal H a signal of a relatively high potential, i.e. a high level signal, is applied to the driver circuit 13 and this high level signal is transmitted through the NOR circuit 11 so as to energise the illuminating device 14. When it is not required to energise the illuminating device, the controlling switch 12 is turned OFF so that it is brought into contact with a terminal L. A signal of a relatively low potential i.e. a low level signal, is thus applied to the driver circuit 13 so that the illuminating device 14 is de-energised.

The alarm device 10 is energised by the driver circuit 9, however the output of the latter is also fed to the NOR circuit 11. If the controlling switch 12 is then turned ON the output signal from the driver circuit 13 is blocked by the NOR gate 11. This has the result that the illuminating means 14 cannot be energised if the alarm device 10 is energised. This has the advantage of increasing the life of a battery driving the digital electronic watch. If the alarm device 10 and the illuminating device 14 were to be energised together, the power drain on the battery would be considerable.

In Figure 2 there is illustrated a second embodiment of a digital electronic watch according to the present invention. Like parts in Figure 1 and 2 have been designated by the same reference numerals. In this embodiment, an output signal from the timekeeping counter circuit 2 is applied to one input terminal of an OR circuit 1a. An output signal from a control switch 16, when ON is applied through a wave-shaping circuit 15 to the other input of the OR circuit 1a. An output signal from the OR circuit 1a and an output signal from the comparison and coincidence circuit 3 are fed to a terminal R and a terminal S respectively of a set-reset flip-flop 17. An output terminal Q of the flip-flop 17 is connected to the driver circuit 9 of the alarm device 10. An output terminal $\bar{Q}$ of

the flip-flop 17 is connected to one input terminal of an AND circuit 18, the other input terminal of which is connected to receive a signal from the control switch 16 when the latter is ON.

An output signal from the AND circuit 18 is connected through the driver 13 circuit to the illuminating device 14.

The digital electronic watch of Figure 2 operates as follows. The time standard signal from the oscillator circuit 1 is counted by the timekeeping counter circuit 2 to produce an actual time of day indication signal. An alarm time is set by means of the alarm time setting circuit 4 and memorised in the alarm time counter circuit 5. When setting the alarm time the contents of the alarm time counter circuit 5 are applied to the display device 8 through the display change-over switching circuit 6 and the decoder/driver circuit 7 under the control of the output signal from the alarm time setting circuit 4.

When it is not necessary to display the alarm time by means of the display device 8, the alarm time setting circuit 4 is rendered inoperative, whereby the contents of the timekeeping counter circuit 2 are displayed by the display device 8 via the display changeover circuit 6 and the decoder/driver 7. Thus the display device 8 selectively displays the time indication and the alarm time.

When the contents of the alarm time counter circuit 5 coincide with that of the timekeeping counter circuit 2, the flip-flop 17 is set by the output signal from the comparison and coincidence circuit 3, and a high level signal appears at the terminal Q of the flip-flop 17. Thus the alarm device 10 is energised to generate a sound thereby to indicate that the actual time of day indication and the alarm time coincide.

In this state, after a predetermined time, a pulse output signal from the timekeeping counter circuit 2 passes to the OR circuit 1a and is applied to the terminal R of the flip-flop 17. Consequently, a high level output signal appear at the terminal $\bar{Q}$ of the flip-flop 17 and a low level signal appears at the output terminal Q, so that the alarm device 10 is de-energised automatically after this predetermined time. The alarm device 10 can also be de-energised manually by turning the control switch 16 ON so that a high level signal is passed to the OR circuit 1a through the wave-shaping circuit 11. Consequently, the flip-flop 17 is re-set so that the alarm device 10 is de-energised.

When it is required to energise the illuminating device 14, the control switch 16 is turned ON so that a high level pulse signal appears at the output of the wave-shaping circuit.

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If coincidence between the alarm time and the actual time of day indication occurs whilst the illuminating device 14 is energised, both the alarm device and the illuminating device are not operated simultaneously and so there is no large power drain on the battery. While the illuminating device 14 is energised, the control switch 16 is ON so that a high level signal appears at the output terminal Q of the flip-flop 17 and a low level signal appears at the output terminal Q as already described. When the alarm time coincides with the time indication, a high level output signal is produced by the comparison and coincidence circuit 3. The output signals from the flip-flop 17 are thus inverted i.e. the output signal of the output terminal Q is a high level signal and the output signal at the output terminal Q is a low level signal. Thus the AND circuit 18 produces a low level signal and consequently the illuminating device 14 is de-energised. 20 25 30

In the digital electronic watch described above the alarm device and the illuminating device cannot be energised simultaneously and the capacity of the battery is not, therefore, abnormally reduced and the amplitude of sound produced by the alarm device can be maintained. 35 40

WHAT WE CLAIM IS:—

1. A digital electronic watch comprising: a time display device; timekeeping means for producing an actual time of day indication, for display by the display device; alarm time storing means; alarm setting means by which an alarm time may be set in the storing means, alarm means for 45

producing a warning when the set alarm time and the actual time of day indication coincide, display illuminating means; and preventing means for preventing more than one of the alarm means and the illuminating means from being in an energised state at any time. 50 55

2. A watch as claimed in Claim 1 in which the preventing means is such that, in operation, if the alarm means is energised when the illuminating means is in an energised state the latter is immediately de-energised. 60

3. A watch as claimed in Claim 1 or 2 including coincidence means for energising the alarm means when the set alarm time and the actual time of day indication coincide. 65

4. A watch as claimed in any preceding claim in which the preventing means is a flip-flop circuit one output of which is connected to energise the alarm means and the other output of which is connected to energise the illuminating means. 70

5. A watch as claimed in any preceding claim including reset means for de-energising the alarm means after a predetermined time. 75

6. A watch as claimed in Claims 1 to 3 in which the preventing means is a NOR circuit, one input of which is connected to receive a signal for energising the illuminating means and the other input of which is connected to receive a signal when the alarm means is energised. 80

7. A watch as claimed in any preceding claim including manually operable switch means for de-energising the alarm means. 85

8. A digital electronic watch substantially as herein described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
Lincoln House,
296—302 High Holborn,
London, WC1V 7JH.



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This high level pulse signal maintains a high level signal at the output terminal Q of the flip-flop 17 so that a high level signal is applied as one input of the AND circuit 18. The other input of the AND circuit 18 is a high level signal brought about when the control switch 16 is turned ON. Thus the AND circuit 18 produces a high level signal which energises the illuminating device via the driver circuit 13.

If coincidence between the alarm time and the actual time of day indication occurs whilst the illuminating device 14 is energised, both the alarm device and the illuminating device are not operated simultaneously and so there is no large power drain on the battery. While the illuminating device 14 is energised, the control switch 16 is ON so that a high level signal appears at the output terminal Q of the flip-flop 17 and a low level signal appears at the output terminal Q as already described. When the alarm time coincides with the time indication, a high level output signal is produced by the comparison and coincidence circuit 3. The output signals from the flip-flop 17 are thus inverted i.e. the output signal of the output terminal Q is a high level signal and the output signal at the output terminal Q is a low level signal. Thus the AND circuit 18 produces a low level signal and consequently the illuminating device 14 is de-energised.

In the digital electronic watch described above the alarm device and the illuminating device cannot be energised simultaneously and the capacity of the battery is not, therefore, abnormally reduced and the amplitude of sound produced by the alarm device can be maintained.

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producing a warning when the set alarm time and the actual time of day indication coincide, display illuminating means; and preventing means for preventing more than one of the alarm means and the illuminating means from being in an energised state at any time.

2. A watch as claimed in Claim 1 in which the preventing means is such that, in operation, if the alarm means is energised when the illuminating means is in an energised state the latter is immediately de-energised.

3. A watch as claimed in Claim 1 or 2 including coincidence means for energising the alarm means when the set alarm time and the actual time of day indication coincide.

4. A watch as claimed in any preceding claim in which the preventing means is a flip-flop circuit one output of which is connected to energise the alarm means and the other output of which is connected to energise the illuminating means.

5. A watch as claimed in any preceding claim including reset means for de-energising the alarm means after a predetermined time.

6. A watch as claimed in Claims 1 to 3 in which the preventing means is a NOR circuit, one input of which is connected to receive a signal for energising the illuminating means and the other input of which is connected to receive a signal when the alarm means is energised.

7. A watch as claimed in any preceding claim including manually operable switch means for de-energising the alarm means.

8. A digital electronic watch substantially as herein described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
Lincoln House,
296—302 High Holborn,
London, WC1V 7JH.