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Tsuruishi

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[54] **ELECTRONIC TIMEPIECE HAVING ALARM MEANS**

[75] Inventor: **Yuki Tsuruishi**, Suwa, Japan

[73] Assignee: **Kabushiki Kaisha Suwa Seikosha**, Tokyo, Japan

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[51] **Int. Cl.** **G04c 21/00**

[58] **Field of Search** ..... 58/23 R, 23 AC, 23 V, 58/38, 57.5

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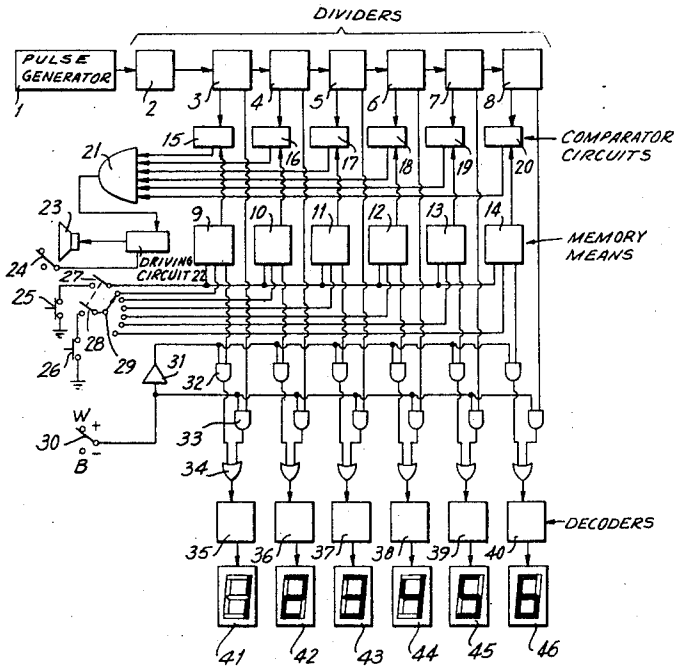
Primary Examiner—George H. Miller, Jr.

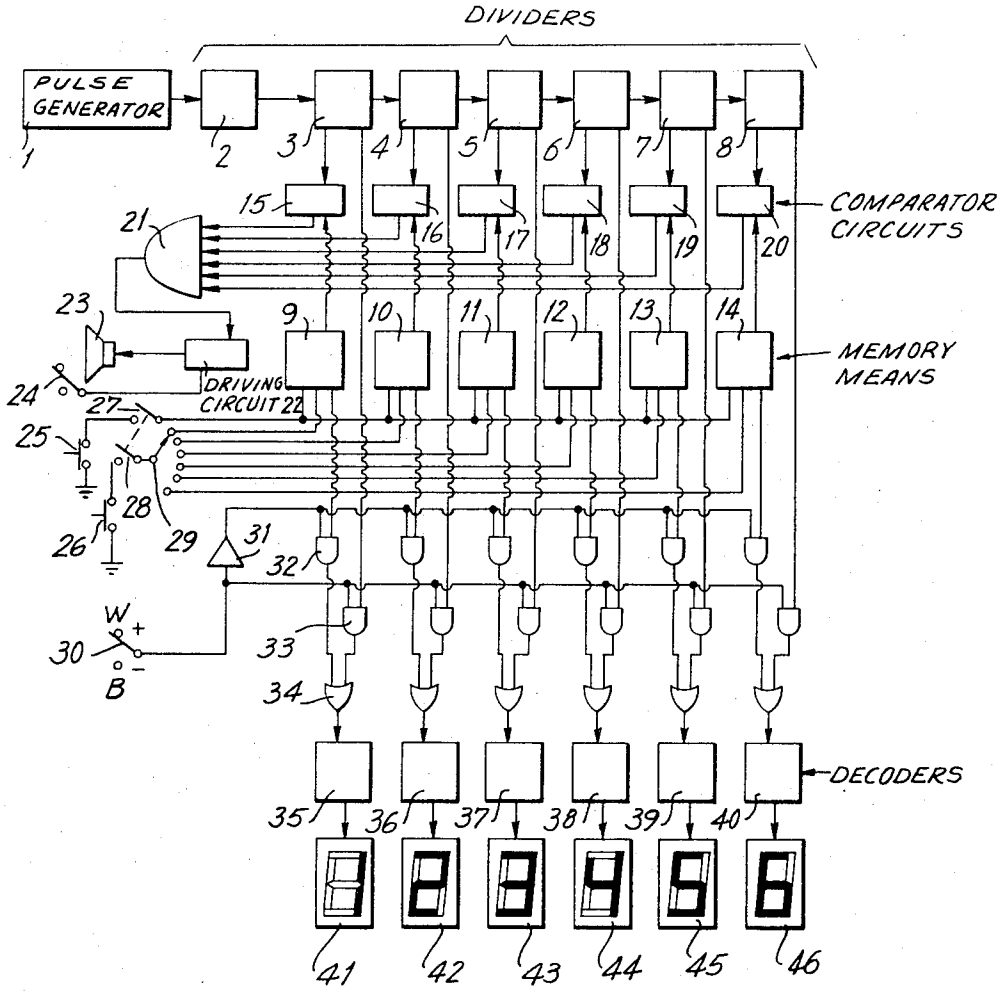
Attorney—Alex Friedman, Lawrence Rosenthal et al.

[57] **ABSTRACT**

An electronic timepiece having a pulse generator for producing a high frequency time standard signal, a divider circuit for producing low frequency timing signals in response to said time standard signal and a device for digitally displaying time in response to said timing signals, is provided with an alarm adapted to be actuated at a predetermined time. The timepiece includes a memory device for storing said predetermined time, a comparator device for comparing the stored predetermined time and the instantaneous information in said divider means and a device for driving said alarm in response to the output of said comparator device.

11 Claims, 1 Drawing Figure




DIVIDERS
PULSE GENERATOR
COMPARATOR CIRCUITS
MEMORY MEANS
DRIVING CIRCUIT 22
DECODERS
W
B
1
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ELECTRONIC TIMEPIECE HAVING ALARM MEANS

BACKGROUND OF THE INVENTION

This invention relates to electronic timepieces incorporating digital displays, and in particular, to small-sized electronic timepieces such as wrist watches. In the art, relatively small digital timepieces, known as cyclemotor clocks driven by alternating current of high voltage have been produced. However, such timepieces cannot be carried for usual use. Accordingly, it is desirable to produce a small-sized digital electronic timepieces, particularly a wrist watch, which can be driven by a battery. The provision of analog time indication, as by the position of watch hands, is widely used in the art. Such analog indication has the advantage or rarely resulting in reading error. On the other hand, the smaller the digital electronic timepiece, the more likely that reading errors will occur. For example, it is readily apparent that digitally displayed 3's and 8's or 7's and 9's may be confused, resulting in a misreading of the time, to the possible substantial detrement of the user. For this reason, as the size of digital electronic timepieces is reduced, it is desirable to provide not only as clear a display as possible, but also an alarm function so as to avoid reading error at critical instants. If such a timepiece is provided with an alarm, the adverse effect of reading error would be minimized.

By providing a small-sized electronic timepiece incorporating a digital display with alarm means such as a buzzer or miniature speaker, the foregoing difficulties with such miniature electronic timepieces may be substantially avoided.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an electronic timepiece is provided including pulse generator means for generating a high frequency time standard signal; divider means for producing low frequency timing signals in response to said time standard signal and representative of present time; and digital display means for the digital display of time in response to said timing signals. An alarm means is provided adapted for actuation at a predetermined time. Timing signals representative of said predetermined time are stored in memory means for comparison with the instantaneous timing signals of said divider means by comparator means. Said alarm means is driven by driving means in response to the output of said comparator means.

Said alarm means may take the form of a buzzer or miniature speaker. A logic gate may be provided for the selective applying of either the instantaneous timing signals of said divider means or the stored timing signals of said memory means to said digital display means for the respective display of present time or said predetermined time. Time setting means may be provided for selectively changing the stored predetermined time in said memory means.

Accordingly, it is an object of this invention to provide a small-sized electronic timepiece provided with a digital display and having an alarm mechanism.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification and drawing.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWING

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawing, in which:

The FIGURE is a logic block diagram of the principal parts of a small-sized electronic timepiece according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, the electronic timepiece depicted includes a pulse generator 1 for producing a high frequency time standard signal. Said pulse generator may take the form of a quartz crystal oscillator, a mechanical vibrator such as a tuning fork vibrator, or the like. The time standard signal output of pulse generator 1 is applied to a divider circuit 2 which consists of a binary divider chain which divides said signal to either a 1-minute or 1-second signal, depending on the digits of time to be displayed. Thus, if the seconds are to be displayed, then divider circuit 2 would produce a 1-second signal having a period of one second. In the embodiment of the FIGURE, seconds are displayed, as would be the case in an accurate digital timepiece. The 1-second signal from divider circuit 2 is applied to a chain of divider circuits 3–8 wbich produce timing signals. Thus, divider circuit 3 is a 1/10 divider circuit for producing a 10-second signal; divider circuit 4 is a 1/6 divider for producing a 1-minute signal; divider circuit 5 is a 1/10 divider circuit for producing a 10-minute signal; divider circuit 6 is a 1/6 divider for producing a 1-hour signal; divider circuit 7 is a 1/10 divider for producing a 10-hour signal and divider circuit 8 is a binary or a 1/3 divider for producing a resetting signal and for counting the 10's digit of the hour.

When external switch 30 is engaged against fixed contact W, a positive voltage is applied to AND gates 33 to open said AND gates and apply the information in divider circuits 3–8, consisting of the instantaneous timing signals counted therein, to OR gates 34 through AND gates 33. Said instantaneous timing signals are applied from the outputs of OR gates 34 to decoders 35–40 which correspond respectively to divider circuits 3–8. Decoder circuits 35–40 translate the timing signals from said divider circuits into a format suitable for driving the respective digits 41–46 of the digital display means. In the embodiment of the invention depicted in the drawing, each of said digits consists of a seven bar display, the corresponding decoder circuit being adapted to produce the appropriate driving signals required to energize the combination of bars of each digit required to digitally display the value of the respective instantaneous timing signals from divider circuits 3–8. Thus, if divider circuit 3 has counted one 1-second signal, this information is transmitted through the associated AND gate 33 and OR gate 34 to decoder 35 which excites only the two right-most vertical bars of digit 41, as shown in the FIGURE. Similarly, digit 42 is excited by the count of the 10-second signal from divider circuit 4; digit 43 is excited by the count of the 1-minute signal from divider circuit 5; digit 44 is excited by the count of the 10-minute signal from divider circuit 6; digit 45 is excited by the count of the 1-hour signal

from divider circuit 7; and digit 46 is controlled by the count of the 10-hour signal from divider circuit 8, digits 41–46 being depicted in inverse order in the FIGURE.

The digital display device incorporated in the electronic timepiece according to the invention may be formed from liquid crystal devices, light emitting devices or other low-power digital display.

When external switch 30 is positioned to engage fixed contact W, a negative signal is applied to AND gates 32 through inverter 31 so that said AND gates are closed. The other input to AND gates 32 are a group of memory means 9–14 corresponding respectively to divider circuits 3–8. When switch 30 is engaged against fixed contact W, so that AND gates 32 are closed, the output of said memory means is not passed through said AND gates to OR gates 34. When switch 30 engages fixed contact B, a negative voltage is applied to AND gates 33 to close said AND gates while a positive voltage is applied by inverter 31 to AND gates 32 to open the latter AND gates. In this state, the information stored in memory circuits 9–14 is applied through AND gates 32 and OR gates 34 to decoders 35–40 respectively. Memory means 9–14 is adapted to store a predetermined time at which an alarm is to sound in a format corresponding to the format of the respective instantaneous timing signals in divider circuits 3–8.

Two ganged switches 27 and 28 are provided in connection with memory means 9–14. In order to set the time when alarm buzzer 23 sounds, switch 30 is positioned in contact with fixed contact B so that the information stored in memory circuits 9–14 is respectively displayed in the digits 41–46 of the digital display device. Switches 27 and 28 are then turned on and the multi-contact rotary switch 29 engages the fixed contact coupled to memory means 9. Each of the memory means is adapted to increase the count of the timing signal stored therein by one each time switch 26 is closed provided rotary switch 29 engages the fixed contact associated therewith. Thus, where rotary switch 29 engages the fixed contact associated with memory means 9, the count stored in memory means 9 increases by one every time switch 26 is closed. In this manner, memory means 9 may be set to the desired second at which the alarm means is to be set. In like manner, each of memory means 10–14 would be set until the precise time in which the alarm means is to go off is displayed on digital display means 41–46 and stored in memory means 9–14. When this process is completed, switches 27 and 28 are turned off and switch 30 is returned to fixed contact W. At this time, time setting for the alarm device is completed.

Switch 25 is provided for simultaneously resetting all of the memory means to 0 when switches 27 and 28 are closed. Said memory means may be formed of divider stages similar in structure to the structure of divider circuits 3–8.

The information stored in memory circuits 9–14 representative of the predetermined time at which the alarm means is to sound, as well as the instantaneous present time from divider circuits 3–8 are applied to comparator circuits 15–20. Said comparator circuits generate an output signal only when the information in each of said memory means corresponds to the instantaneous present time in the corresponding divider circuit. The outputs of comparator circuits 15–20 are applied to AND gate 21. When all of said comparator circuits generate an output signal, representing the instant at which the present time corresponds to the predetermined time stored in memory means 9–14, a pulse output is produced by AND gate 21 to trigger driving circuit 22 to sound buzzer 23.

Driving circuit 22 is adapted to continuously function for a predetermined period of time. Thus, buzzer 23 may be driven for a predetermined number of seconds. Switch 24 is provided for manually stopping the operation of driving circuit 22 to turn buzzer 23 off.

Means may be provided for automatically turning switch 24 off during the setting of the alarm to avoid actuation thereof. A miniature speaker or other alarm means can be utilized in place of buzzer 23. Driving circuit 22 can consist of an amplifier which amplifies the signals of a predetermined frequency obtained from the time standard signal or a divider stage, which amplified signals are applied to the alarm means. All or some of the circuits of the electric timepiece in accordance with the invention may be formed of complimentary or MOS (metal oxide semiconductor transistor) integrated circuits. When said integrated circuits are utilized, a small-sized electronic timepiece having a digital display and an alarm, but consuming only small amounts of power may be provided. As used herein, "small-sized timepiece" refers to a timepiece which can be readily carried in normal use, such as a wrist watch.

It will thus be seen that the objects set forth above, and those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. An electric timepiece comprising pulse generator means for generating a high frequency time standard signal; divider means for producing low frequency signals in response to said time standard signal, said timing signals being representative of present time; digital display means for the digital display of time in response to said timing signals; alarm means for actuation at a predetermined time; memory means for storing timing signals representative of said predetermined time said timing signals being representative of a plurality of digits of time; time setting means coupled to said memory means for selectively individually setting each digit of said predetermined time and for selectively resetting said stored signal of said memory means at the zero value; comparator means for comparing the instantaneous timing signals of said divider means with the stored timing signals of said memory means for producing an output signal; and driving means for driving said alarm means in response to the output signal of said comparator means.

2. An electronic timepiece as recited in claim 1, wherein said alarm means is a buzzer.

3. An electronic timepiece as reicted in claim 1, wherein said alarm means is a miniature speaker.

4. An electronic timepiece as recited in claim 1, wherein said divider means, memory means and com-

parator means are formed from complementary MOS integrated circuits.

5. An electronic timepiece as recited in claim 1, wherein said driving means includes an amplifier for amplifying the signals of predetermined frequency obtained from one of said pulse generator means and divider means.

6. An electronic timepiece as recited in claim 1, wherein said driving means includes means for automatically cutting off said alarm means after the passage of a predetermined time period starting from the receipt of an output signal from said comparator means.

7. An electronic timepiece as recited in claim 1, including logic gate means for selectively connecting one of said memory means and said divider means to said digital display means for the selective display of said predetermined time or present time in response to said stored timing signals or said instantaneous timing signals from said divider means respectively.

8. An electronic timepiece as recited in claim 7, including decoder means intermediate said logic gate means and said digital display means for converting said timing signals to a form adapted to drive said digital display means.

9. An electronic timepiece as recited in claim 8, wherein said digital display means is a liquid crystal display means.

10. An electronic timepiece as recited in claim 8, wherein said digital display means is formed from light emitting elements.

11. An electric timepiece comprising pulse generator means for generating a high frequency time standard signal; divider means for producing low frequency timing signals in response to said time standard signal, said timing signals being representative of present time; digital display means for the digital display of time in response to said timing signals; alarm means for actuation at a predetermined time; memory means for storing time signals representative of said predetermind time, said timing signals being representative of a plurality of digits of time; time setting means for selectively adjusting the stored timing signals in said memory means to said predetermined time, said time setting means including first switch means for generating a time setting signal which when applied to a digit of said memory means indexes said digit by one number, and second switch means for selectively connecting said first switch means to each of said digits of said memory means; comparator means for comparing the instantaneous timing signals of said divider means with the stored timing signals of said memory means for producing an output signal; and driving means for driving said alarm means in response to the output signal of said comparator means.

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