

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO ELECTRONIC TIMEPIECES

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese company, of 6-31-1, 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 electronic timepieces.

Electronic timepieces capable of performing the function of a normal time keeper and also, when desired, that of a stop watch or chronograph, have already been proposed. Generally speaking such timepieces are arranged simply to perform the function of an ordinary stop watch, and, when it is desired to observe lapse of time during a time measurement, or to determine a particular time period, it is necessary to watch a time indicator visually indicating the passage of time. This may be very inconvenient in some cases. Obviously a timepiece which merely indicates time or lapse of time visually is useless to a blind person or to any person in an environment of such darkness that the visual indicator cannot be seen. The present invention seeks to provide improved electronic timepieces in which the results of measurement of time or lapse of time by time counting means is made known or can, when desired, be made known, by sound emitting means conveying said results by the emission of sound.

According to this invention there is provided an electronic timepiece having means for counting and displaying normal time of day and, additionally, means for counting time for a stop watch function includes also means, operating when the timepiece is set to perform said stop watch function, for generating sounds at desired intervals, to convey by said sounds information of time elapsed during the performance of

said stop watch function.

The timepiece may include means for visually displaying normal time and time elapsing during the performance of the stop watch function and means for inhibiting, when desired, the production of said sounds.

The sounds generated may be pulse sounds.

The information conveying sounds may be coded sound signals and these may be coded in Morse code.

Means may be provided for conveying, by means of the sounds generated, whether the timepiece is operating to display normal time of day or is performing the stop watch function.

In one embodiment of the invention an electronic timepiece includes first time counting means for counting normal time of day, second time counting means for counting elapsed time, time counting memory means, and switch selecting means controlled by a control circuit arrangement, for selecting the contents of said first or second time counting means or of said time counting memory means. Said control circuit arrangement may be subjected to joint control by manually operable switch means and by the output of a coincidence detector detecting coincidence between the contents of said first time counting means and said time counting memory means.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a face view of one example of a watch embodying the invention;

Figure 2 is a block diagram of the circuitry of the watch of Figure 1; and

Figure 3 shows the circuitry of the control circuit unit 9 of Figure 2.

Referring to Figure 1 the electronic wrist watch therein represented has a case 1 with a window through which the visually indicating means 2 of the watch can be

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seen. Projecting from the edge of the casing 1 are three control stems 4, 5 and 6, which control manually operable switches as will be later described herein.

5 Referring now to Figure 2, there is a time standard oscillator 7 constituted by a quartz crystal controlled oscillator the output from which is fed to a multi-stage frequency divider 8. 9 is a control circuit
10 arrangement having two input terminals 9a and 9b and twenty output terminals 9c to 9v. Two different output frequencies, in the present example of 100Hz and 1Hz, and taken from two different divider stages
15 in the divider 8, are fed in to the unit 9 at its terminals 9a and 9b respectively. From the output terminal 9c is taken a time standard reference frequency signal of 1Hz which is fed to a first time counter
20 unit 10 which is used for counting normal time of day. The first time counter 10 comprises a seconds counter 11, counting to 60, a minutes counter 12, counting to 60, an hour counter 13, counting to 24, and
25 three OR gates 14, 15 and 16. The OR gate 14 receives as one input the 1Hz signal from terminal 9c and, as its other input, a signal from terminal 9d. The output from gate 14 constitutes the count input to the
30 seconds counter 11. The OR gate 15 receives as one of its inputs the count output from the seconds counter 11 and, as its other input, pulse signals fed from terminal 9e. The output from gate 15 constitutes the input to the minutes counter
35 12. The OR gate 16 receives, as one input, the count output from the minutes counter 12 and, as its other input, a pulse signal from terminal 9f.
40 At the terminal 9g there appears a pulse signal of 1Hz which is fed to a counter unit 18 which forms part of a pulse sound generating device 17. The counter unit 18 comprises a seconds counter 19, counting
45 to 60, a minutes counter 20, counting to 60, and an hours counter 21, counting to 24. Outputs from the counter unit 18 are supplied to a coincidence detecting circuit 22.
50 The pulse sound generating device 17 includes a memory unit 23 which comprises a seconds memory 24, a minutes memory 25, and an hours memory 26 to which are supplied pulses from the output terminals
55 9i, 9j, 9k respectively. Outputs from the memory unit 23 are also fed to the coincidence detecting circuit 22 which compares the contents of the count unit 18 with those of the memory unit 23 and detects coincidence therebetween. Output
60 from the memory unit 23 is fed via an OR gate 27 to the reset terminal R of the counter unit 18. The OR gate 27 has one input fed from the coincidence detector
65 circuit 22 and the other fed from the ter-

minal 9h. The output from the coincidence detector circuit 22 is also fed to a pulse sound generating circuit 28 which generates pulse sounds of an audible frequency.

A 100Hz signal is fed from the terminal 70 9i to a further time counter unit 29 which is used for stop watch time counting, i.e. elapsed time. The time counter unit 29 comprises a 1/100th of a second counter 30 counting to 100, a seconds counter 31,
75 counting to 60, and a minutes counter 32, counting to 60. The stop watch counter unit 29 has a re-set terminal R which is connected to terminal 9m.

33 is a selecting switching circuit to 80 which the respective contents of the first and second time counter units 10 and 29 and of the memory unit 23 are supplied, and which is controlled by control signals from the terminals 9n, 9o and 9p of the
85 control circuit unit 9. These control signals control the switching circuit 33 to cause it to select either the contents of one of the time counter units 10, 29 or of the memory unit 23 and forward the selected
90 contents both to a decoder-driver 34 driving the visual indicating means 2 of the watch, and also to a switching circuit 36 including a sound display device 35. The switching circuit 36 is controlled by pulses which
95 are fed out successively from the terminals 9p to 9v of the control circuit 9. The control effected by these signals is such that the switching circuit 36 changes over at every digit so that it successively supplies
100 to a decoder 37 the counts of the counters in the selected time counter unit 10 or 29 or in the memory unit 23 in accordance with which has been selected by the selecting switching circuit 33. 38 is an encoded
105 pulse generating circuit which converts the contents of the decoder 37, which it receives, into a corresponding Morse code audio signal which it feeds into a sound
110 producer 39.

Figure 3 shows the circuitry of the control circuit arrangement 9 of Figure 2. The various terminals in Figure 3 are referenced in the same way as are those in Figure 2.

Referring to Figure 3, a first switch 40 is operated by the stem 5 of Figure 1. This stem, when pushed, in causes the switch 40 to close on its contact 40a and when pulled out causes said switch to close
120 on contact 40b. A second switch 41 is actuated by the stem 4 and is closed by pushing in said stem. A third switch 42 is actuated by stem 6 and closed by pushing said stem. When switch 40 is closed on
125 contact 40a a signal is supplied to a 3-bit ring counter 43 and when it is closed on contact 40b a signal is supplied through an inverter 44 to one input of a three-input OR gate 45 the output from which
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is passed to one input of a two-input AND gate 46, the other input of which receives the 1Hz signal from terminal 9b. The output from AND gate 46 is fed to the terminal 9c.

Output from the terminal Q_1 of the ring counter 43 is fed to one input of each of three four-input AND gates 47, 48 and 49.

Output from the terminal Q_2 of the ring counter 43 is supplied to one input of the OR gate 45, and also to one input of each of three four-input AND gates 51, 52 and 53, and in addition to the output terminal 9o. Output from the terminal Q_3 of the ring counter 43 is fed to the remaining input of the OR gate 45 and also to the output terminal 9p.

When switch 41 is closed a signal is supplied to a three bit ring counter 55. Output from terminal Q_1 of this ring counter 55 is fed to the second inputs of each of the three AND gates 47, 50 and 51 and also to one input of an AND gate 54. Output from the terminal Q_2 of ring counter 55 is fed to the second inputs of the AND gates 48 and 52. Output from the terminal Q_3 of the ring counter 55 is supplied to the second inputs of the AND gates 49 and 53 and also to the terminals 9h and 9m.

When switch 40 is closed on to its contact 40b a signal is applied to one input of an AND gate 56 the output of which is fed to the third inputs of each of the AND gates 47, 48, 49, 51, 52 and 53.

The remaining inputs of all the AND gates 47 to 53 are supplied with the 1Hz signal from terminal 9b. The outputs from the AND gates 47 to 50 are fed to the output terminals 9d to 9g respectively and the outputs of the AND gates 51 to 53 are fed to the output terminals 9i to 9k respectively. To the remaining input terminal of the AND gate 54 is supplied a 100Hz signal from terminal 9a and the output of said gate is fed to terminal 9l.

57 is an AND gate to one input of which is supplied the 1Hz signal from 9b and to the other input of which is supplied output from the terminal Q_1 of the ring counter 43. Output from this gate 57 is fed to one input of a three-input OR gate 60. Another AND gate 58 has one of its inputs fed with the 1Hz signal from 9b and its other input fed from the terminal Q_2 of the ring counter 43. The output from AND gate 58 is supplied to the second input of OR gate 60. A three-input AND gate 59 has one input fed with the 1Hz signal from 9b, its second input fed from the terminal Q_3 of the ring counter 55, and its third input fed from the output terminal Q_3 of the ring counter 43. The output from gate 59 is fed to the remaining

input of OR gate 60.

Output from the OR gate 60 is fed to a time pulse generating circuit 61 producing a pulse at two seconds intervals. A signal obtained when the switch 40 is closed on its contact 40b is fed through an inverter 62 to one input of an AND gate 63 the second input of which receives the signal obtained when switch 42 is closed and the output of which is fed to the input terminal C of an FF (flip-flop) 64. The Q output of this flip-flop is fed to one input of an AND gate 65 the second input of which receives the output from the time pulse generating circuit 61. The output from the AND gate 65 is fed to the clock input terminal c of a 7-bit ring counter 66 having output terminals Q_1 to Q_7 . Outputs from the terminal Q_1 to Q_6 of this ring counter are fed to the output terminals 9q to 9v respectively. Output from the remaining terminal Q_7 is fed directly to one input of an AND gate 70, and also through three inverters 67, 68 and 69 in series to the other input of said AND gate 70, the output from which is fed to the reset terminal R of the FF 64.

The operation of the above described timepiece will be described.

When normal time is to be displayed, the switch 40 is closed on its contact 40a causing a signal of logic "1" to appear at the output terminal Q_1 of the ring counter 43 and a "1" signal to appear at terminal 9n of control circuit arrangement 9. In response to this signal, the selecting switching circuit 33 selects the first time counter unit 10 and feeds out its contents. Similarly, when a "1" signal appears at the output terminal Q_2 or Q_3 of the ring counter 43, the display change-over circuit 33 changes over to select the contents of the memory unit 23 or the contents of the second time counter unit 29, as the case may be.

The contents of the selected counter unit or memory unit are displayed via the decoder 34 by means of the visual indicating device 2. On the representation of the said visual indicating device 2 in Figure 1 are shown the letters N.W., T.A., and S.W. These letters refer to the different functions which the watch can be controlled to perform, the letters N.W. being displayed when the watch is set to display the contents of the first time counter unit 10; T.A. being displayed when the watch is set to display the contents of the memory unit 23; and S.W. being displayed when the watch is set to display the contents of the second time counter unit 29.

The operation of the pulse/sound generating device 17 will now be described.

First, the switch 40 is actuated so as to cause display of the contents of the memory unit 23 in the visual display device

2. For this operation the stem 5 is pulled out so as to make the switch 40 close on its contact 40b. In order (for example) to generate pulse sounds every five seconds, the switch 42 is operated to set the contents of the seconds memory 24 in the memory unit 23 to "5" and to set the contents of the minutes memory 25 and the hours memory 26 to "0". After these setting operations, the switch 41 is closed once and a "1" signal is fed out from terminal Q₁ of the ring counter 55 in order to start the counter unit 18 counting.

When the contents of the seconds counters 19 and memory 24 coincide, a coincident pulse is fed out from the coincidence detection circuit 22 to reset the counter unit 18 and to cause the generation of a pulse sound signal from the pulse sound signal generating circuit 28. These operations will then repeat and pulse sounds will be generated every five seconds.

The counter unit 18 and the memory unit 23 can be set, in one second steps, for any value up to twenty four hours, so that pulse sounds of any desired repetition intervals up to 24 hours can be obtained. Thus if the electronic watch is to be used to count a relatively short time, the user can be informed of a time lapse merely by listening to the pulse sounds and does not have to look at the visual display. This enables the user correctly to be informed of a time lapse without difficulty.

With relatively little, and obvious, modification of the pulse sound generating circuit 28, the timepiece can be used as an alarm timepiece.

In order to cause the watch to function as a stop watch, the switch 41 is actuated to display the contents of the second time counter unit 29 in the visual display device 2. When the switch 41 is closed to produce an output from the output terminal Q₁ of the ring counter 55, the second time counter unit 29 starts to count and is stopped when an output appears at the output terminal Q₂. Next, the second time counter unit 29 is caused to reset by output from the output terminal Q₃.

Simultaneously with a counting operation as above described, the pulse sound generating device 17 operates. A switch (not shown) may be provided to prevent the operation of the device 17 when not required. Such a switch could, for example, be included in some essential circuit of the pulse sound generating circuit 28.

When switch 42 is closed, "1" signals sequentially appear at the output terminals Q₁ to Q₇ of the ring counter 66 and signals corresponding with the contents of the counter or memory unit (as the case may be) selected by the selecting switching

circuit 33 are sequentially changed at each digit, fed out through the switch circuit 36, and supplied to the encoder pulse generating circuit 38 through the decoder 37 so as to change them to decimal code. Morse code signals generated by the encoder pulse generating circuit 38, and corresponding with the output signals from the switch circuit 36 are supplied to the sound signal generating circuit 39 which produces audible Morse code sound signals of predetermined audio frequency. Accordingly, when the first time counter unit 10 is selected by the selecting switching circuit 33, actuation of the switch 42 causes the time to be heard and, in the same manner information of the time interval of the pulse sound (the contents of the memory unit 23) and the contents of the second time counter unit is conveyed by sound. The contents of the second time counter unit 29 will change at very high speed during an elapsed time counting or measuring period, so that in order to display by sound only the time period of the stopping of counting in the second time counter unit 29, the AND gates 57 to 59 and the OR gate 60 are provided in the control circuit arrangement 9.

As will now be appreciated, the above described timepiece can convey, by sound, information as to the counts made and, accordingly, a blind person can make effective use of the timepiece and, similarly, any person can effectively use it in an environment too dark for him to see the visual display.

While the described and illustrated embodiment of the invention is at present preferred, it will be apparent that many modifications are possible without departing from the scope of the invention as defined in the claims. For example, by suitable modification of the pulse sound generating apparatus 17, the sound display apparatus 35 of the timepiece can be arranged to indicate time by sound at every hour. Also it would be a comparatively simple matter to distinguish by sound a counted or measured result of a stop watch operation and ordinary time of day by using different encoded sounds therefor.

As will now be understood the invention provides an electronic timepiece which has a pulse sound generating apparatus for generating pulse sounds at a desired fixed time interval, so that the user can be informed of the elapse of time merely by sound. Furthermore, the timepiece can be used effectively to determine some frequency so that a blind person or a person in the dark can determine time by means of information conveyed by sounds indicating time or frequency by encoded sounds. The encoding is not dependent on varying

individual sound strengths or durations so that there is no likelihood of user error such as would be caused were the conveying of information dependent on a musical tone or pitch.

Attention is directed to our Patent No. 1527939 which claims an electronic chronograph comprising a first timekeeping circuit for producing a time of day indication; a second timekeeping circuit for producing an elapsed time indication; visual display means for selectively displaying the time of day indication and the elapsed time indication; audible warning means; and time counter means for causing the audible warning means to be periodically and momentarily energised with passage of the elapsed time indication. We do not claim in the present specification anything already claimed in our said Patent No. 1527939 but, subject to this disclaimer,

WHAT WE CLAIM IS:—

1. An electronic timepiece having means for counting and displaying normal time of day and, additionally, means for counting time for a stop watch function, including means, operating when the timepiece is set to perform said stop watch function, for generating sounds at desired intervals, to convey by said sound information of time elapsed during the performance of said stop watch.

2. A timepiece as claimed in claim 1 wherein the timepiece has means for visually displaying normal time of day and time elapsing during the performance of the stop watch function and means for inhibiting, when desired, the production of said sounds.

3. A timepiece as claimed in claim 1 or 2 wherein the sounds generated are pulse

sounds.

4. A timepiece as claimed in any of the preceding claims wherein the information conveying sounds are coded sound signals.

5. A timepiece as claimed in claim 4 wherein the coded sound signals are Morse code signals.

6. A timepiece as claimed in any of the preceding claims wherein means are provided for conveying, by means of the sounds generated, whether the time piece is operating to display normal time of day or is performing the stop watch function.

7. A timepiece as claimed in any of the preceding claims and having first time counting means for counting normal time of day, second time counting means for counting elapsed time, time counting memory means, and switch selecting means controlled by a control circuit arrangement, for selecting the contents of said first or second time counting means or of said time counting memory means.

8. A timepiece as claimed in claim 7 wherein said control circuit arrangement is subjected to joint control by manually operable switch means and by the output of a coincidence detector detecting coincidence between the contents of said first time counting means and said time counting memory means.

10. Electronic timepiece substantially as herein described and illustrated in the accompanying drawings.

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1. An electronic timepiece having means for counting and displaying normal time of day and, additionally, means for counting time for a stop watch function, including means, operating when the timepiece is set to perform said stop watch function, for generating sounds at desired intervals, to convey by said sound information of time elapsed during the performance of said stop watch.

2. A timepiece as claimed in claim 1 wherein the timepiece has means for visually displaying normal time of day and time elapsing during the performance of the stop watch function and means for inhibiting, when desired, the production of said sounds.

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4. A timepiece as claimed in any of the preceding claims wherein the information conveying sounds are coded sound signals.

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6. A timepiece as claimed in any of the preceding claims wherein means are provided for conveying, by means of the sounds generated, whether the time piece is operating to display normal time of day or is performing the stop watch function.

7. A timepiece as claimed in any of the preceding claims and having first time counting means for counting normal time of day, second time counting means for counting elapsed time, time counting memory means, and switch selecting means controlled by a control circuit arrangement, for selecting the contents of said first or second time counting means or of said time counting memory means.

8. A timepiece as claimed in claim 7 wherein said control circuit arrangement is subjected to joint control by manually operable switch means and by the output of a coincidence detector detecting coincidence between the contents of said first time counting means and said time counting memory means.

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