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(54) ELECTRONIC TIMEPIECE

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese Body Corporate, 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.

In some conventional electronic timepieces, AM and PM are distinguished by causing a particular display element (e.g. a colon between an hours indication and a minutes indication, or a display element displaying a days indication) on a display panel to flash. Alternatively, a display element separate from the display elements displaying the time indication may be provided to display continuously an indication representative of AM and PM.

If AM and PM are distinguished by causing a particular display element to flash, it is impossible for a user to distinguish between AM and PM unless he is familiar with the mode of operation of the electronic timepiece. If a separate display element is provided to distinguish between AM and PM this is disadvantageous from a point of view of manufacturing costs and reliability since two additional output terminals from an integrated circuit of the electronic timepiece are required, and, moreover, it is difficult to find sufficient space on the display panel to accommodate this separate display element, especially in the case of an electronic wristwatch.

According to the present invention, there is provided an electronic timepiece comprising: timekeeping means for producing timing signals; a time display device consisting of a plurality of digital display portions for displaying a time indication in response to said timing signals; and distinguishing means which, when operated, modifies a display produced by one of said digital display portions selectively to provide a display indicative of AM and PM; and correcting means for selectively correcting at least the minutes time indication and the

hours time indication, the arrangement being such that said distinguishing means is only operable when the hours time indication is corrected.

In the preferred embodiment the time-keeping means includes an oscillator circuit for producing a standard time signal; frequency dividing means for frequency dividing a standard time signal; decoder means for producing decoded signals in response to output signals from the frequency dividing means; and driving means for driving the display device in response to the decoded signals from the decoder means.

The distinguishing means may comprise a gate circuit connected between the decoder means and the driving means, the gate circuit being arranged to modify some of the decoded signals when operative and to pass some of the decoded signals when inoperative.

In the preferred embodiment the display device is a digital display device; the distinguishing means being arranged to produce a display of the letter A indicative of AM and a display of the letter P indicative of PM. Preferably the electronic timepiece includes switch means which, when in one position, enables the time indication to be corrected, the arrangement being such that when said switch means is in one position, the distinguishing means is rendered operative.

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

Figure 1 is a block diagram of one embodiment of an electronic timepiece according to the present invention;

Figure 2 is a circuit diagram of a decoder circuit of the electronic timepiece of Figure 1 and

Figure 3 illustrates displays produced by part of a display device of the electronic timepiece of Figure 1.

Referring to Figure 1 there is illustrated one embodiment of an electronic timepiece according to the present invention. The electronic timepiece comprises an oscillator

circuit 7 which produces a standard time signal, a divider circuit 12 for frequency dividing the standard time signals to produce a 1-minute signal i.e. a signal having a frequency of 1/60Hz, a divide-by-ten counter 13 for counting units of minutes, a divide-by-six counter 14 for counting tens of minutes, a divide-by-twelve counter 15 for counting hours, a decoder circuit 17 which receives outputs from the counters, 13, 14, 15, and a display driving circuit 19 which receives outputs from the decoder circuit 17 and drives a digital display device 20.

One minute figure outputs 1A—1G of the decoder circuit 17 for causing a units of minutes display portion of the display device 20 to display units of minutes are connected with a gate circuit 18. The gate circuit 18, as shown in Figure 2, consists of OR gates 31, 32, 34, 37, 38, 39 and AND gates 33, 35, 36. One input of the gates 31, 32, 33, 35, 36, 37, 38, 39 is connected to a respective one output of the decoder circuit 17 and the other input is connected to a line 22. The inputs of the AND gates 35, 36 connected to the line 22 are inverting inputs.

A manually operable time correction switch 21, which enables the time indication displayed by the display device 20 to be corrected is usually in the open condition so that the line 22 is logic 0. Thus, the signals appearing at the output 1A—1G of the decoder circuit 17 are fed unchanged through the driving circuit 19 via the gate circuit 18 so that the units of minutes display portion of the display device 20 displays a units of minutes indication as illustrated in Figure 3(a). That is to say, the gates, 33, 34, 35, are controlled by the signal at output 1C of the decoder circuit 17 irrespective of the signal on a line 24 from a flip-flop counter 16 connected to receive an output from the counter 15.

When the switch 21 is in the closed condition, the line 22 becomes logic 1. The gates 31—34, 36—39 of the gate circuit 18 are open and the gate 35 is closed so that the signal on the line 24 from flip-flop counter 16 appears at an output 2C. Outputs 2A, 2B, 2E, 2F, 2G of the gate circuit 18 become logic 1 and an output 2D, becomes logic 0. Figure 3 shows the relationship between each segment of the units of minutes display portion and the outputs 2A—2G of the gate circuit 18.

When the switch 21 is closed and the output 2D becomes logic 0 so that the corresponding segment of the unit of minutes display portion is de-energised. The outputs 2A, 2B, 2E, 2F, 2G, are logic 1 so that the corresponding segments of units of minutes display portion are energised. Thus the units of minutes display portion produces the display illustrated in Figure 3(b) namely letter A if the output 2C of the gate circuit 18

is logic 1 and produces the display illustrated in Figure 3(c), namely the letter P, if the output to C of the A/P decoder is logic 0. The output 2C of the gate circuit 18 is logic 1 if the signal on the line 24 from the flip-flop counter 16 is logic 1 and is logic 0 if the signal on the line 24 is logic 0.

It will be appreciated that a display indicative of AM and PM is only produced when the hours indication is corrected, i.e. when the switch 21 is operated. This is because a person using the electronic timepiece, e.g. electronic wristwatch, seldom requires to read the display indicative of AM and PM except when correction of the hours indication is performed. It is, therefore, pointless to display AM and PM all the time.

The electronic timepiece is illustrated above enables AM and PM to be clearly displayed without having to provide a separate display element and without having to increase the number of output terminals of integrated circuitry connected with the display device 20.

In the illustrated embodiment the units of minutes display portion is used to display AM and PM, however, any other portion of the display device may be so used, e.g. a tens of minutes display portion, a days display portion, or a months display portion.

WHAT WE CLAIM IS:—

1. An electronic timepiece comprising: timekeeping means for producing timing signals, a time display device consisting of a plurality of digital display portions for displaying a time indication including at least a minutes time indication and an hours time indication in response to said timing signals; distinguishing means which, when operated, modifies a display produced by one of said digital display portions selectively to provide a display indicative of AM and PM and correcting means for selectively correcting at least the minutes time indication and the hours time indication, the arrangement being such that said distinguishing means is only operable when the hours time indication is corrected.

2. An electronic timepiece as claimed in claim 1 in which the timekeeping means includes an oscillator circuit for producing a standard time signal, frequency dividing means for frequency dividing a standard time signal, decoder means for producing decoded signals in response to output signals from the frequency dividing means, and driving means for driving the display device in response to the decoded signals from the decoder means.

3. An electronic timepiece as claimed in claim 2 in which the distinguishing means comprises a gate circuit connected between the decoder means and the driving means,

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circuit 7 which produces a standard time signal, a divider circuit 12 for frequency dividing the standard time signals to produce a 1-minute signal i.e. a signal having a frequency of 1/60Hz a divide-by-ten counter 13 for counting units of minutes, a divide-by-six counter 14 for counting tens of minutes, a divide-by-twelve counter 15 for counting hours, a decoder circuit 17 which receives outputs from the counters, 13, 14, 15, and a display driving circuit 19 which receives outputs from the decoder circuit 17 and drives a digital display device 20.

One minute figure outputs 1A—1G of the decoder circuit 17 for causing a units of minutes display portion of the display device 20 to display units of minutes are connected with a gate circuit 18. The gate circuit 18, as shown in Figure 2, consists of OR gates 31, 32, 34, 37, 38, 39 and AND gates 33, 35, 36. One input of the gates 31, 32, 33, 35, 36, 37, 38, 39 is connected to a respective one output of the decoder circuit 17 and the other input is connected to a line 22. The inputs of the AND gates 35, 36 connected to the line 22 are inverting inputs.

A manually operable time correction switch 21, which enables the time indication displayed by the display device 20 to be corrected is usually in the open condition so that the line 22 is logic 0. Thus, the signals appearing at the output 1A—1G of the decoder circuit 17 are fed unchanged through the driving circuit 19 via the gate circuit 18 so that the units of minutes display portion of the display device 20 displays a units of minutes indication as illustrated in Figure 3(a). That is to say, the gates, 33, 34, 35, are controlled by the signal at output 1C of the decoder circuit 17 irrespective of the signal on a line 24 from a flip-flop counter 16 connected to receive an output from the counter 15.

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In the illustrated embodiment the units of minutes display portion is used to display AM and PM, however, any other portion of the display device may be so used, e.g. a tens of minutes display portion, a days display portion, or a months display portion.

WHAT WE CLAIM IS:—

1. An electronic timepiece comprising: timekeeping means for producing timing signals, a time display device consisting of a plurality of digital display portions for displaying a time indication including at least a minutes time indication and an hours time indication in response to said timing signals; distinguishing means which, when operated, modifies a display produced by one of said digital display portions selectively to provide a display indicative of AM and PM and correcting means for selectively correcting at least the minutes time indication and the hours time indication, the arrangement being such that said distinguishing means is only operable when the hours time indication is corrected.

2. An electronic timepiece as claimed in claim 1 in which the timekeeping means includes an oscillator circuit for producing a standard time signal, frequency dividing means for frequency dividing a standard time signal, decoder means for producing decoded signals in response to output signals from the frequency dividing means, and driving means for driving the display device in response to the decoded signals from the decoder means.

3. An electronic timepiece as claimed in claim 2 in which the distinguishing means comprises a gate circuit connected between the decoder means and the driving means,



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the gate circuit being arranged to modify some of the decoded signals when operative and to pass some of the decoded signals when inoperative.

5 4. An electronic timepiece as claimed in any preceding claim in which the distinguishing means is arranged to produce a display of the letter A indicative of AM and a display of the letter P indicative of PM.

10 5. An electronic timepiece as claimed in any preceding claim including a switch means which, in one position, enables the

time indication to be corrected, the arrangement being such that when said switch means is in said one position, the distinguishing means is rendered operative. 15

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

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