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(19)

(54) ELECTRONIC TIMEPIECE

(71) We, CASIO COMPUTER COMPANY LIMITED, a Japanese corporation, of 6-1, 2-chome, Nishishinjuku, Shinjuku-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 a date display type electronic timepiece capable of functioning as a stopwatch.

With the advent of a digital display type electronic timepiece a variety of compact wristwatches of such type have been deviced. Such wristwatches are adapted to display time data corresponding to minutes and hours on a display section made of a liquid crystal, LED etc. An attempt has been made to display a date data on the display section. In this case, a date data is displayed by the operation of a display changeover switch on the display section. An attempt has also been made to incorporate, in addition to such functions, another function such as the function of a stopwatch into the wristwatches. It is necessary in this case to give a time count start instruction and time count stop instruction and display the measured time interval on the display section. Such a time interval needs to be displayed on a time or date display section in view of a limited display space. When the wristwatch performs the function of a wristwatch, if a long time interval is involved, there arises a necessity for reading a normal time data on the same wristwatch. As a result, many changeover switch mechanisms are required to effect a time count control and display changeover control, providing a bar to the miniaturization of the wristwatch.

It is accordingly the object of this invention to provide an electronic timepiece which can readily and effectively display a date display function and a stopwatch function selectively as corresponding time data on the same display section, as required, through the control of two switches and provide a great merit when the timepiece is made compact as in the case of a wristwatch.

According to this invention there is provided an electronic timepiece comprising a time of day data counting means connected to count reference clock signals as time of day data at all times; display means arranged to display the time of day count data of said time of day data counting means; calendar data counting means for counting carry signals from said time of day data counting means; a display changeover switch operable to cause the coupling of calendar data from the calendar data counting means to the display means instead of the data from said time of day counting means; further time counting means provided independently of said time of day data counting means and said calendar data counting means and arranged to count reference clock signals; switch instruction means for giving a time count start instruction and time count stop instruction to said further counting means; means for selectively applying the count value of said further time counting means to said display means in response to an instruction signal from said switch instruction means; detection means for detecting the operation of said display changeover switch while the count value of said further counting means is displayed on said display means and for producing a detection signal; and display control means for causing other count data to be displayed on said display means, instead of the count value of said further time counting means, in response to a detection output from said detection means.

The electronic timepiece according to this invention can display a date data on

the indicator through the control of the two switches and provide a great merit when the timepiece is made compact as in the case of a wristwatch.

This invention will be further described by way of example by referring to the accompanying drawings in which:

Figure is a block circuit diagram showing one embodiment of this invention.

One embodiment of this invention will be described by referring to an accompanying drawing.

In the drawing a reference clock signal is generated from an oscillator 11. The reference clock signal is properly frequency divided at a frequency divider 12 to produce, for example, a one pulse per 0.1 second (1P/0.1S) clock signal. The clock signal of the frequency divider 12 is supplied as a count step signal to a second counting circuit 13 comprised of, for example, scale of 10 and scale of 60 counters. The second counting circuit 13 produces a one pulse per minute (1P/1M) output signal. The 1P/1M signal of the second counter 13 is supplied as a count step signal to a time counting circuit 14 comprised of a scale of 60 and scale-of-12 counters etc. The time counting circuit 14 provides a minute and hour indication. One pulse per 24 hours (1P/24H) carry signal may be produced by the time counting circuit 14 and fed to a date counting circuit 15 by which, for example, output signals representative of a "a month", "a date" and "a day of the week" may be produced.

Tthe count signals of the counting circuits 14 and 15 are supplied to AND circuits 16 and 17 and the output signals of the AND circuits 16 and 17 are supplied, as a display signal, through an OR circuit 18 to a digital type indicator 19 having a display section indicating time in units of "one hour" and "one minute".

The 1P/0.1S signal of the frequency division circuit 12 is coupled as a count step signal through an AND circuit 20 to a smaller time unit counting circuit 22 which constitutes a time count circuit for performing the function of a stopwatch. A carry signal from the counting circuit 22 is coupled as a count step signal to a greater time unit counting circuit 23. The counting circuits 22 and 23 are constructed in the same way as the secound counting circuit 13 and time counting circuit 14. That is, the counting circuit 22 is adapted to count the time in smaller time units of 0.1 to 60 seconds while the gate of the AND circuit 20 is opened and the counting circuit 23 is adapted to count the time in greater time units of minutes and hours. The count signals of the counting circuits 22 and 23 are supplied to AND circuits 24 and 25, respectively, and the outputs of the AND circuits 24 and 25 are coupled through the OR circuit 18 to the indicator 19 so as to provide a stopwatch function.

An electronic timepiece includes a first switch KA of the auto-return type which is open during normal time counting periods and is closed to select a specific function, and a second switch KB for selecting the stopwatch function. These switches produce a +V signal upon closure. A signal produced upon the closure of the first switch KA is coupled to the AND circuits 17 and 24 and to AND circuits 26 and 27 and inverter 28. When the switch KA is opened, the inverter 28 produces an output signal. The output of the inverter 28 is coupled as a gate signal to AND circuits 25 and 29. The outputs of the AND gates 27 and 29 are coupled to an OR 30 and the output of the OR circuit 30 is supplied as a gate signal to the AND circuit 16.

A signal produced upon the closure of the second switch KB is supplied as an inversion trigger signal to a binary flip-flop 31 adapted to invert the above-mentioned signal for each closure of the switch KB. The above-mentioned signal is also connected to the AND circuit 26. The AND circuit 26 is arranged to produce upon the simultaneous operation of the switches KA and KB an output signal which is supplied as a reset instruction to the time counting circuits *21* and to an RS flip-flop 32. The RS flip-flop 32 is set when the binary flip-flop 31 produces an output "1". The output "1" of the binary flip-flop 31 is supplied as a gate signal to the AND circuit 20. The set output of the flip-flop 32 is applied as a gate signal to the AND circuit 25. The output of the binary flip-flop 31 is also coupled through an inverter 33 to one gate of the AND circuit 35, and the output of the binary flip-flop 31 and the set output of the flip-flop 32 are coupled to an AND circuit 34. The set output of the flip-flop 32 is also coupled to the AND circuit 35. The output of the AND circuit 34 is connected to the AND circuit 27 and the output of the AND circuit 35 is connected to the AND circuit 24. The reset output of the flip-flop circuit 32 is connected to the AND circuits 29 and 17.

When the electronic timepiece functions as a normal timepiece, not as a stopwatch, the binary flip-flop 31, flip-flop 32 and time counting circuits *21* are all in the reset state, the second counting circuit 13 is counting the time in units of a second and the time counting circuit 14 is counting the time in units of a minute and an hour. In this state, the flip-flop 32 is in the reset state and an output signal of the AND gate 29 is supplied through the OR circuit

30 to the AND gate 16. In consequence, a time count signal of the time counting circuit 14 is supplied to the indicator 19 where the time is being displayed.

When the date is to be displayed on the same indicator 19, the first switch KA is closed. Since the inverter 28 produces an output "0", the AND gate 29 is closed and the AND gate 16, to which the minute/hour count signal is coupled, is closed, interrupting the time of day display on the indicator 19. At the same time, the AND gate 17 is opened and the output signal of the date counting circuit 15 is coupled to the indicator 19, thus effecting a date display on the indicator 19. That is, the time and date are selectively displayed on the indicator 19 in response to the closure of the first switch KA and the timepiece is used as a normal timepiece having a date display.

Where the timepiece is to be used as a stopwatch, the second switch KB is momentarily closed with the first switch KA in the open state. The binary flip-flop 31 is set to cause the AND gate 20 to be opened. A clock signal from the frequency divider 12 is delivered to the time count circuit *21*. That is, upon the closure of the second switch KB the timepiece starts to function as a stopwatch. At the same time the set output of the flip-flop 31 causes the flip-flop 32 to be set, supplying a gate signal to the AND gate 25. Since at this time the output of the inverter 28 is "1" with the first switch KA in the open state, the AND gate 25 is opened, a time count signal from the greater time unit counting circuit 23 is thus coupled to the indicator 19, effecting a minute/hour time display. When in this state the second switch KB is again momentarily closed, the output of the binary flip-flop 31 is reversed. That is, the binary flip-flop 31 produces an output "0". The gate of the AND gate 20 is closed, thus stopping the time counting operation of the time counting circuit 21. That is, the timepiece functions as a stopwatch and a start/stop operation is so effected. Since at this time the flip-flop 32 has been set by the initial closure of the second switch KB, the count value of the minute/hour time counting circuit 23 in the start/stop time counting circuit 21 is displayed on the indicator 19.

While the timepiece is working as a stopwatch, if a long time interval is involved, there arises the necessity of reading an actual time during the time counting period. Since the time is read with the binary flip-flop 31 in the set state and the gate of the AND circuit 20 in the open state, the user closes the first switch KA only. Since at this time the flip-flop circuit 32 is set as described above, the set output of the flip-flop circuit 32 is coupled as a gate signal to the AND gate 27 through the AND gate 34. Upon the closure of the first switch KA the AND gate 27 produces an output signal to cause the gate of the AND gate 16 to be opened. Since the inverter 28 produces an output "0", the gate of the AND gate 25 is closed, a time count signal of the minute/hour counting circuit 14 is coupled to the indicator 19 for time display, while the time counting circuit 21 continues its time counting operation. That is, upon the closure of the first switch KA a time display can be effected on the indicator 19 without interrupting the stopwatch function. In this case, the time display is effected in time units of minutes and hours. However, there arises the necessity of effecting a time display in the smaller time units of a second and 0.1 second. Where a number of smaller time units is to be displayed on the indicator 19, the first switch KA is closed under the condition that the above-mentioned time counting is completed and the result of counting is held in the time counting circuit 21. That is, the first switch KA is closed when the flip-flop 31 is in the reset state and the flip-flop circuit 32 is in the set state. In this state, the inverter 33 produces an output "1" and the AND gate 35 produces an output. Simultaneously with the closure of the first switch KA the AND gate 25 is closed and the AND gate 24 is opened. That is, the output signal of the smaller time unit counting circuit 22 is coupled to the indicator 19, effecting a time display in time units of a second and 0.1 second.

If in this state the electronic timepiece is to be used as a normal timepiece, the first and second switches KA and KB are simultaneously operated. Then, the AND gate 26 produces an output signal, and the flip-flop 32 and time count circuit *21* are reset by the output of the AND gate 26. At this time, the output of the binary flip-flop 31 becomes zero.

WHAT WE CLAIM IS:

1. An electronic timepiece comprising a time of day data counting means connected to count reference clock signals as time of day data at all times; display means arranged to display the time of day count data of said time of day data counting means; calendar data counting means for counting carry signals from said time of day data counting means; a display change-over switch operable to cause the coupling of calendar data from the calendar data counting means to the display means instead of the data from said time of day counting means; further time counting means provided independently of said time of day data counting means and said calender data counting means and arranged to

count reference clock signals; switch instruction means for giving a time count start instruction and time count stop instruction to said further counting means; means for selecitvely applying the count value of said further time counting means to said display means in response to an instruction signal from said switch instruction means; detection means for detecting the operation of said display changeover switch while the count value of said further counting means is displayed on said display means and for producing a detection signal; and display control means for causing other count data to be displayed on said display means, instead of the count value of said further time counting means, in response to a detection output from said detection means.

2. An electronic timepiece according to claim 1, in which said detection means includes a first detector for detecting that said changeover switch is operated during the operation of said further time counting means and for producing a detection signal; and said display control means comprises means for displaying the time of day count data of said time of day data counting means, instead of the count value of said further time counting means, on said display means according to the detection signal of said first detector.

3. An electronic timepiece according to claim 1 or 2 in which said further time counting means includes a greater time unit counting section and a smaller time unit counting section; said means for selectively applying the count value of said further time counting means to said display means is arranged to apply a count value of said greater time unit counting section to said display means in response to the instruction signal from said switch instruction means; said detection means includes a second detector for detecting that said changeover switch is operated during the stopping of said further time counting means and for producing a detection signal; and said display control means comprises means for displaying a count value of said smaller time unit counting section, instead of a count value of said greater time unit counting section, on said display means in response to a detection signal from said second detector.

4. An electronic timepiece according to any one of claims 1, 2 and 3 and further including reset means arranged to reset said further time counting means when said display changeover switch and a switch of said switch instruction means are simultaneously operated.

5. An electronic timepiece according to claim 4 in which means are provided whereby when said further time counting means is reset by said reset means a time of day count data from said time of day data counting means is coupled to said display means for display.

6. An electronic timepiece substantially as hereinbefore described with reference to the accompanying drawing.

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