

PATENT SPECIFICATION

(11)

1 551 857

9

1 551 857

- (21) Application No. 43728/76 (22) Filed 21 Oct. 1976
(31) Convention Application No. 50/128057 (32) Filed 24 Oct. 1975 in
(33) Japan (JP)
(44) Complete Specification published 5 Sept. 1979
(51) INT. CL.² G04C 23/08 // 21/12 23/12
(52) Index at acceptance
G3T 402 405 406 608 611 AAA S2



(54) IMPROVEMENTS IN OR RELATING TO DIGITAL ALARM ELECTRONIC TIMEPIECES

(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 a digital alarm electronic timepiece, that is to say to digital electronic timepieces with provision for giving an alarm at the end of a required pre-set time..

The main object of the invention is to provide improved and relatively simple digital alarm electronic timepieces in which alarm time setting can be very easily and conveniently effected by the user. The invention also seeks to provide improved and relatively simple digital alarm electronic timepieces in which time changes such as time changes consequent upon longitude changes by a traveller-user using a timepiece—e.g. a change from a standard time kept in one country to a different standard time kept in another—can be easily and conveniently taken into account. Such time changes are often required to be taken into account, not only when travelling from one country to another but when the time kept is changed for any reason, e.g. from or to "summer" time.

According to this invention there is provided a digital alarm electronic timepiece comprising actual time of day counting means, pre-settable alarm time interval storage means constituted by reversible counting means arranged to count up when an alarm time interval is being set therein, means actuated after setting of an alarm time interval for causing said reversible counting means to count down, an alarm device, and means for actuating the same when the count in said reversible counting means is zero.

The timepiece may comprise means operable to select either the contents in said actual time of day counting means or the contents in said reversible counting means to be displayed by a common display. There may be provided selecting switch operated means selectably operable for utilising said reversible counting means to store alarm time or to provide indication of time of day in a changed time zone.

A preferred embodiment of the invention includes actual time of day counting means constituted by seconds, minutes and hours counters, reversible counting means constituted by second, minutes and hours counters which are reversible together in their directions of count; a common display; a switching circuit controlled by a display selecting switch for selecting either the contents of the counters in said time of day counting means or the contents of the counters in said reversible counting means for display by said common display; an alarm setting control circuit; a change-over control circuit; and an alarm/time change selector switch which, in its alarm position, selects said reversible counters for use as alarm counters under the control of said alarm setting control circuit, counting up when an alarm time interval is being set, or down after an alarm time interval has been set, and which, in its other position, selects said counters for use to provide indication of time of day in a changed time done under the control of said change-over control circuit.

The invention is illustrated in Figure 1 of the accompanying drawings which is a block diagram of one embodiment of the said invention Figure 2 showing a well-known form of circuit which can be used for each of the control circuits 9 and 10 of Figure 1.

Referring to the drawing, a time standard relatively high frequency quartz oscillator

and a frequency divider into which said oscillator feeds, are included in block 1, the output from which is a 1 Hz signal, i.e. a seconds signal. This is fed to a seconds counter 2 followed by a minutes counter 3 in turn followed by an hours counter 4. This sequence of oscillator and counters constitutes the time counting means of the timepiece.

Block 8 represents a selecting switch the output terminal of which is directly connected to one input of a NOR gate 16 and one input of an OR gate 24 and is also connected, through an inverted 15, to one input of a NOR gate 17 and one input of an AND gate 26. Block 9 represents an alarm time change control circuit and block 10 represents a duo-time changing circuit. As will be clear later these two control circuits equally affect both the alarm time interval set and displayed and the time of day displayed. The two said control circuits are as well-known per se and are similar. Figure 2 shows one of them, the references used being appropriate for the control circuit 9. As will be seen it includes two manually operable switches 9x and 9y; two anti-chatter circuits ACx and ACy for eliminating the effects of switch contact bounce; a latching circuit L consisting of three flip-flops and a pair of NOR gates; a so-called "one-shot" multi-circuit M consisting of three flip-flops and a NOR gate; an RS flip-flop RS; and a NOR gate N to the inputs of which are applied, respectively, and as shown, three different frequency inputs obtained from convenient points in the divider included in block 1 of Figure 1. The output points 9a, 9b correspond with the similarly referenced points in Figure 1. The operation is as well known. When switch 9x is closed the one-shot multi-circuit M is operated and a pulse signal is produced at point A. After this, a pulse signal is produced at point B each time the switch 9y is closed and is applied to the count change inputs of counters 5, 6 and 7 via AND gate 18 and OR gate 23. When switch 9x is opened again the flip-flop RS is re-set by the pulse thus produced at point B and the output 9a becomes "0". During setting of the alarm time each "1" signal appearing at 9a is applied to the remaining inputs of NOR gate 16 and OR gate 24 and also to one input of an AND gate 18. The circuitry in block 10 is as already stated, the same as that in block 9 and its operation is similar. To effect duo-time change a switch corresponding to 9x is closed and, after this, each time a switch corresponding to 9y is closed a "1" signal appears at 10a (Figure 1). This "1" signal is applied to the remaining input of the NOR gate 17 and also to one input of an AND gate 19. The output of NOR gate 16 is applied to one in-

put of an AND gate 20 and the output of NOR gate 17 is applied to one input of an AND gate 21. The one second signal output from the divider in block 1 is applied to the remaining inputs of the AND gates 20 and 21, the outputs from which are applied to the respective inputs of an OR gate 22. The output from this OR gate 22 is applied to the input of an alarm time change seconds counter 5 which will be hereinafter referred to as the "A/D seconds counter". Counter 5 is a 60 counter and its output is applied to an alarm time change minutes counter 6, hereinafter termed an "A/D minutes counter". This is also a 60 counter and its output is applied to an alarm time change hours counter 7, hereinafter referred to as an "A/D hours counter". The A/D counters 5, 6 and 7 are all up/down counters, i.e. they can be controlled to count either up or down. When the output signal from OR gate 24, to which the outputs from the selecting switch 8 and the control circuit 9 are applied, is a "1", the three A/D counters 5, 6 and 7 operate as up counters and, when the output of said OR gate is "0", said A/D counters 5, 6 and 7 operate as down counters. The signals appearing at output terminal 9b of the control circuit 9 are used as display amending signal pulses for providing a digital display of the set alarm time. This terminal 9b is connected to the remaining input of the AND gate 18, the output from which is applied to one input of an OR gate 23. The signals appearing at output terminal 10b of control circuit 10 are used as display amending signal pulses for providing a digital display of changed time. This terminal 10b is connected to the remaining input of AND gate 19, the output from which is applied to the remaining input of OR gate 23. The output from OR gate 23 is applied to the count amending input terminals of the A/D counters 5, 6 and 7. As will now be appreciated, in operation the 1 Hz signal from the divider 1 is selectively applied to the OR gate 23 of the seconds counter 5 which consists of seven flip-flop stages. In the case of the alarm time set condition the output of AND gate 18 is applied to one input of OR gate 23; in the case of the duo time change condition the output of AND gate 19 is applied to the other input of OR gate 23.

The contents of the time counter 2, 3 and 4 are applied to one set of input terminals of a display selecting circuit 12 and the contents of the A/D counters 5, 6 and 7 are applied to the other set of input terminals of said display selecting circuit 12. This selecting circuit 12 determines whether the contents of the time counters 2, 3 and 4 or the contents of the A/D counters 5, 6 and 7 are applied to a decoder-driver 13

for driving a digital display 14. The selecting circuit 12 is controlled by a selecting switch 11 by means of which determination is made as to whether the contents of counters 2, 3 and 4 of the counters 5, 6 and 7 are displayed at 14.

The outputs of the A/D counters 5, 6 and 7 are also applied to the respective inputs of a 3-input NOR gate 25, the output of which is applied to the one input of an AND gate 26, the second input to which is the output from the inverter 15. The output of AND circuit 26 is applied to the input terminal of an alarm driver 27, the output from which operates any convenient alarm device 28, e.g. a buzzer or, as represented, a speaker.

When the switch 11 is switched to the alarm display position (the lower position in the figure) the display selecting circuit 12 applies only the contents of said A/D counters 5, 6 and 7 to the decoder-driver 13, and said contents are displayed by the display device 14. When the selecting switch 8 is switched to the alarm position (the lower position in the figure) it gives a "0" output, and the output of NOR gate 16 becomes "1" of the other input of said NOR gate 16 is "0", i.e. if the alarm setting is not being altered. In this condition the AND gate 20 passes the 1 Hz signal from 1 to the A/D seconds counter 5 via the OR gate 22. In the case now being described both inputs of the or gate 24 are "0", A/D counters 5, 6 and 7 operate as down counters, and the counts therein are reduced by the 1Hz signals applied thereto. When the contents of the A/D counters 5, 6 and 7 are all "0", NOR gate 25 produces a "1" output. At this time both inputs of AND gate 26 are "1" and the alarm driver operates the alarm device 28. At this time, on the other hand, the output of the inverter 15 is "1" so that the output of NOR gate 17 is "0", and the AND gate 21 is closed

If, however, the alarm time is being set, the alarm change control circuit 9 is operated and a "1" appears at its output terminal 9a. The output of NOR gate 16 accordingly becomes "0" and the AND gate 20 is closed, in this case AND gate 21 is closed, and there is no output from OR gate 22 to the A/D seconds counter 5. Also, when the output terminal 9a becomes "1", the output of OR gate 24 becomes "1" thus changing the direction of count in the counters 5, 6 and 7 from down to up. It is thus possible to set the alarm to go off at a required time corresponding with the up count of hours and minutes in the A/D counters as hereinafter described. After setting the alarm time, the output terminal 9a of circuit 9 becomes "0", the output of OR gate 24 becomes "0" and the A/D counters 5, 6 and 7 change over to the down counting

mode. When the signal at output terminal 9a becomes "0", the AND gate 20 opens and the 1Hz signal is applied to the input of the A/D seconds counter 5 via the OR gate 22, and down counting occurs. When the counts all the A/D counters 5, 6 and 7 are zero the pre-set alarm is given. The speed of the count is the same whether counting is up or down, being determined by the signal from the divider in block 1. It may be chosen at any desired value within a wide range.

Time change operation will now be described.

When the selecting switch 8 is switched to the time change position (the upper position in the figure), the output from said switch becomes "1", the output of NOR gate 16 becomes "0", and the AND gate 20 is closed. If, at this time, no change is being effected, the output terminal 10a of the time change control circuit 10 is "0", the NOR gate 17 has two "0" inputs (the other is the "1" from the switch 8, inverted by the inverter 15), the output of the said NOR gate 17 becomes "1" and the AND gate 21 opens, passing the 1Hz signal via OR gate 22 to the counter 5. At this time, when the input terminal of OR gate 24 connected to the selecting switch 8 is "1", OR gate 24 has a "1" output. Therefore the A/D counters 5, 6 and 7 operate as up counters counting upwards the 1Hz signals applied to A/D seconds counter 5 via AND gate 21 and OR gate 22.

If it is required to effect a change of the time displayed from that kept in one place (e.g. in one country) to that kept in another, the signal at the terminal 10a of the time change control circuit 10 is changed from "0" to "1" by operation of said circuit 10. When this happens the output of NOR gate 17 becomes "0", and AND gate 21 is closed. Since AND gate 20 is also closed, the output of OR gate 22 becomes "0" and therefore the 1Hz signal from block 1 is not applied to the A/D seconds counter 5. To take an example, New York time is 14 hours ahead of Japanese time and a traveller flying from New York to Japan or vice versa and wishing to adjust the timepiece to take this into account would have to adjust for a time change of 14 hours. Displayed time change amending signals for such a time change are produced from the terminal 10b of the time change control circuit when the switches in that circuit are operated to effect the required change and are applied to the count changing input terminals of the A/D counters 5, 6 and 7 via the AND gate 19 and OR gate 23, each pulse produced by closure of the switch 10y producing a shift of the displayed time.

When selecting switch 11 switched to its alarm display position (the lower position

(12)

in the figure) the contents of the A/D counters 5, 6 and 7 are displayed by the display device 14. It is thus possible to effect an alarm change while watching the display.

When an operation of time change is finished the terminals 10a and 10b of the time change control circuit 10 become "0", the output of NOR gate 17 becomes "1" again and the AND gate 21 is opened. Therefore the 1Hz signal is applied to the A/D seconds counter 5 via AND gate 21 and OR gate 22, and the contents of the counter is increased by 1 at each second pulse. In this case, the output of the OR gate 24 is maintained at "1", and the A/D counter is operated as an up counter.

It is thus possible to read present time by switching switch 11 to its time display position or to read a different time (e.g. that kept in another country) by switching said selecting switch 11 to its other position.

In the case of operating the changed time function if, when the contents of the A/D counters 5, 6 and 7 are "0", i.e. correspond to 0 hours, 00 minutes and 00 seconds, and the NOR gate 25 has a "1" output, a "0" signal is applied from the selecting switch 8 to one input terminal of the AND gate 26 via the inverted 15, the AND gate 26 becomes closed, and the alarm 28 is not operated because its driver 27 is OFF.

Attention is directed to the invention claimed in claim 1 of Patent No. 1 391 235 (Kabushiki Kaisha Seikosha) and also to our Patent No. 1 505 333 and to our co-pending Application No. 41595/76 (Serial No 1 540 148 which contains related subject matter.

WHAT WE CLAIM IS:—

1. A digital alarm electronic timepiece comprising actual time of day counting means pre-settable alarm time interval storage means constituted by reversible counting means arranged to count up when an alarm time interval is being set therein, means actuated after setting of an alarm time interval for causing said reversible counting means to count down, an alarm device, and means for actuating the same when the count

in said reversible counting means is zero.

2. A timepiece as claimed in claim 1 and comprising switch means operable to select either the contents in said actual time of day counting means or the contents in said reversible counting means to be displayed by a common display.

3. A timepiece as claimed in claim 1 or 2 and including selecting switch operated means selectively operable for utilising said reversible counting means to store alarm time or to provide an indication of time of day in a changed time zone.

4. A timepiece as claimed in claim 3 and comprising actual time of day counting means constituted by seconds, minutes and hours counters, reversible counting means constituted by seconds, minutes and hours counters which are reversible together in their direction of count; a common display; a switching circuit controlled by a display selecting switch for selecting either the contents of the counters in said time of day counting means or the contents of the counters in said reversible counting means for display by said common display; an alarm setting control circuit; a change-over control circuit; and an alarm/time change selector switch which, in its alarm position, selects said reversible counters for use as alarm counters under the control of said alarm setting control circuit, counting up when an alarm time interval is being set or down after an alarm time interval has been set, and which, in its other position, selects said counters for use to provide indication of time of day in a changed time zone under the control of said change-over control circuit.

5. A digital alarm electronic timepiece substantially as herein described and illustrated in Figure 1 of the accompanying drawings.

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



(6) (12) 4
in the figure) the contents of the A/D counters 5, 6 and 7 are displayed by the display device 14. It is thus possible to effect an alarm change while watching the display.

When an operation of time change is finished the terminals 10a and 10b of the time change control circuit 10 become "0", the output of NOR gate 17 becomes "1" again and the AND gate 21 is opened. Therefore the 1Hz signal is applied to the A/D seconds counter 5 via AND gate 21 and OR gate 22, and the contents of the counter is increased by 1 at each second pulse. In this case, the output of the OR gate 24 is maintained at "1", and the A/D counter is operated as an up counter.

It is thus possible to read present time by switching switch 11 to its time display position or to read a different time (e.g. that kept in another country) by switching said selecting switch 11 to its other position.

In the case of operating the changed time function if, when the contents of the A/D counters 5, 6 and 7 are "0", i.e. correspond to 0 hours, 00 minutes and 00 seconds, and the NOR gate 25 has a "1" output, a "0" signal is applied from the selecting switch 8 to one input terminal of the AND gate 26 via the inverted 15, the AND gate 26 becomes closed, and the alarm 28 is not operated because its driver 27 is OFF.

Attention is directed to the invention claimed in claim 1 of Patent No. 1 391 235 (Kabushiki Kaisha Seikosha) and also to our Patent No. 1 505 333 and to our co-pending Application No. 41595/76 (Serial No 1 540 148 which contains related subject matter.

WHAT WE CLAIM IS:—

1. A digital alarm electronic timepiece comprising actual time of day counting means pre-settable alarm time internal storage means constituted by reversible counting means arranged to count up when an alarm time interval is being set therein, means actuated after setting of an alarm time interval for causing said reversible counting means to count down, an alarm device, and means for actuating the same when the count

in said reversible counting means is zero. 50

2. A timepiece as claimed in claim 1 and comprising switch means operable to select either the contents in said actual time of day counting means or the contents in said reversible counting means to be displayed by a common display. 55

3. A timepiece as claimed in claim 1 or 2 and including selecting switch operated means selectively operable for utilising said reversible counting means to store alarm time or to provide an indication of time of day in a changed time zone. 60

4. A timepiece as claimed in claim 3 and comprising actual time of day counting means constituted by seconds, minutes and hours counters, reversible counting means constituted by seconds, minutes and hours counters which are reversible together in their direction of count; a common display; a switching circuit controlled by a display selecting switch for selecting either the contents of the counters in said time of day counting means or the contents of the counters in said reversible counting means for display by said common display; an alarm setting control circuit; a change-over control circuit; and an alarm/time change selector switch which, in its alarm position, selects said reversible counters for use as alarm counters under the control of said alarm setting control circuit, counting up when an alarm time interval is being set or down after an alarm time interval has been set, and which, in its other position, selects said counters for use to provide indication of time of day in a changed time zone under the control of said change-over control circuit. 65 70 75 80 85

5. A digital alarm electronic timepiece substantially as herein described and illustrated in Figure 1 of the accompanying drawings. 90

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