

METHOD AND CIRCUIT FOR CONTROLLING A DIGITAL TIMEPIECE
BY USING ONE BUTTON

The present invention relates to a method and a circuit for controlling a digital timepiece using one button, and particularly, enables the two functions of mode conversion and number increment to be performed by operating one switch.

A conventional digital liquid crystal timepiece has two or more switches, one of them being a switch to change the adjustment mode between minute, hour, date or month adjustment, the other being a switch to increment the displayed number indicating the minute, hour, date or month in the respective adjustment mode.

Fig. 3 of the accompanying drawings is a block diagram of the major circuit components of the known digital liquid crystal timepiece having both a mode conversion switch and a number increment switch, Fig. 4 being a flow chart illustrating the method of controlling the circuit of Fig. 3. According to the flow chart of Fig. 4, the method of controlling the known digital liquid crystal timepiece of Fig. 3 is described as follows.

The mode conversion switch (SW1) is operable to change the adjustment mode of minute, hour, date or

month, once for each mode change in the normal display condition, the conversion being made sequentially to month adjustment mode, date adjustment mode, hour adjustment mode, minute adjustment mode. In the
5 normal display condition, the hour and minute are displayed in display window and the colon between the hour and minute flickers every second, whereby in this normal display condition the flow of time is represented in a lifelike manner.

10 When the normal display condition is converted to one for an adjustment mode by the mode conversion switch (SW1), the number to be adjusted flickers, then if the number increment switch (SW2) is operated, the flickering number is incremented according to the
15 number of operations of the switch SW2 or is incremented rapidly in proportion to the duration of the switch operation if such operation is maintained for a long time.

The month, date, hour, minute of the known
20 digital liquid crystal timepiece can be adjusted as desired by the above method. When adjustment has been completed, the normal display condition is restored by depressing the mode conversion switch (SW1).

On the other hand, Fig. 4 illustrates an example
25 of the method of controlling the known digital liquid crystal timepiece. The sequence of conversion between

the adjustment modes may be different from Fig. 4, and one or more other adjustment functions may be inserted or substituted for existing functions. For example, an adjustment function for a displayed day of the week may be inserted and then the number increment switch (SW2) increments a sequence of letters representing the days of the week.

If the digital liquid crystal timepiece is arranged to operate according to the above method of control at least two switches are necessary.

The present invention aims to simplify the arrangement of the digital liquid crystal timepiece by allowing the two functions of mode conversion and number increment to be performed with one switch.

The present invention also aims to provide a convenient switching operation for instantly converting between the adjustment modes and for number increment.

According to the invention there is provided a method for controlling an adjustment mode conversion and for adjusting a time display of a digital timepiece, comprising the steps of:

selecting one of a plurality of adjustment modes associated with respective different time display components by operating a switch and entering the selected adjustment mode directly from normal time

display of the timepiece; and

adjusting the time display component associated with the selected adjustment mode in accordance with further operation of the switch once an adjustment mode has been selected.

According to the invention there is also provided a control circuit for adjusting a digital time display in a timepiece wherein the circuit is responsive to the operation of a manually operable element of the timepiece during normal time display to select between a plurality of adjustment modes associated with respective different time display components for direct entry from the normal time display to the selected adjustment mode, and wherein once a said mode has been selected, the circuit is responsive to further operation of the same said element to adjust the associated time display component.

Reference will now be made to the accompanying drawings, in which;

Fig. 1 is a block diagram of the digital liquid crystal timepiece adapted to provide mode conversion and number increment using one switch, according to the present invention;

Fig. 2 is the flow chart illustrating the control method for performing mode conversion and number increment by operating the digital liquid crystal timepiece with one switch, according to the present



invention;

Fig. 3 is the block diagram of a known digital liquid crystal timepiece which has two switches, respectively, for performing mode conversion and number increment; and

Fig. 4 is a flow chart illustrating the known control method to perform mode conversion and number increase using two switches.

An embodiment of the invention will now be described with reference to the block diagram Fig. 1 and the flow chart Fig. 2.

In Fig. 1, numeral 100 designates an oscillator outputting 2^{15} Hz, number 101 designates a 15 stage divider to perform a 15 stage division of the 2^{15} Hz signal and thus produce from its final stage an output of 1Hz. Numeral 103 designates a mode setting circuit selecting one of two advance selectors 108, 109 according to the switch (SW1) input signal, numeral 104 designates a normal mode return circuit, numeral 107 designates a switched frequency selection circuit, which outputs different frequencies selected according to the input condition of switch (SW1) from the inputted 4Hz and 32Hz output signals from the 15 stage divider 101.

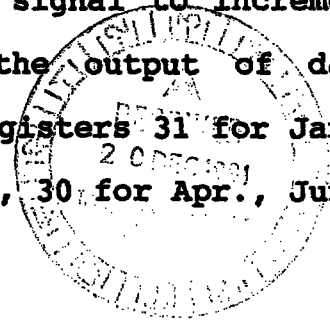
Numerals 110, 111, and 112 designate counters for calculating each second, minute/hour, date/month, and

numeral 116 designates a decoder for illustrating numbers or letters through a display window.

Fig. 2 represents briefly, the operation of the block diagram of Fig. 1 in accordance with the present invention.

The control method in accordance with the present invention adjusts the digital liquid crystal timepiece illustrated by the block diagram of Fig. 1, with one switch (SW1). A description of the control method follows.

First, the second counter (110) counts the output signal F1 of 15 stage divider (101) in the normal condition in which switch (SW1) is not operated. When the second counter 110 counts 60, the carry signal is input to the minute/hour counter (111) to increment the minute count. If the minute counter counts 60, the hour counter is incremented. If the hour counter counts 24, the carry signal is then input into the date/month counter (112); if the date counter increments and counts up to a designated number, the months counter is incremented. The said date/month counter (112) is connected to a decoder (117), which generates the carry signal to increment the month count according to the output of date counter, when the date counter registers 31 for Jan., Mar., May, July, Aug., Oct., Dec., 30 for Apr., June,



Sep., Nov., and 28 for Feb.

There will now be described the operation whereby input switch (SW1) converts the adjustment mode.

First of all, when the switch SW1 is inputted, its pulse is inputted to the mode setting circuit 103 through the debouncing circuit (102), and mode setting circuit 103 designates one of the advance selectors 108, 109 according to the time the switch SW1 is pushed. That is, if switch SW1 is inputted once and the input condition is held continuously for more than three seconds, the advance selector 108 is designated and selects the minute/hour adjustment mode, whereas if switch SW1 is inputted twice within one second, the advance selector 109 is designated and selects the day/month adjustment mode. The detection of the input time of the switch SW1 is carried out by a flipflop circuit within the mode setting circuit.

The output signal of the mode setting circuit 103 thus designates one of the said two adjustment modes and also enables the frequency selection circuit 107 through OR gate 105.

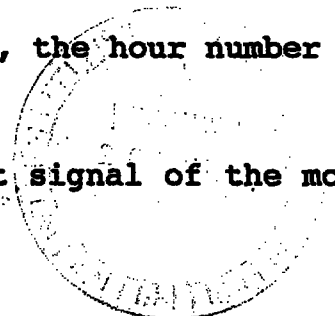
If switch SW1 is now inputted, the output signal of the frequency selection circuit (107) is applied to the present designated advance selector. Then, at the frequency selection circuit (107) the output signal is changed according to the input signal of the switch

(SW1). If one pushes the switch (SW1) intermittently, the pulse is outputted intermittently and applies the number increment signal to the minute/hour counter (111) or date/month counter (112) through the
5 designated advance selector.

If one pushes the switch (SW1) between two to four seconds continuously, the frequency selection circuit (107) increments the number in the present adjustment mode by outputting the 4Hz frequency
10 inputted from the F4 stage of the 15 stage divider (101). If one pushes the switch (SW1) for more than five seconds continuously, the frequency selection circuit (107) increments the number of the present adjustment mode by outputting the 32Hz frequency
15 inputted from the F32 stage of the 15 stage divider (101).

Therefore, if the present adjustment mode is the minute/hour adjustment mode selected, as described earlier by operating the switch (SW1) for more than
20 three seconds in the normal display condition, the output signal of the advance selector (108) is inputted to minute/hour counter (111) and increments the displayed minute number; if this minute number increases so that the carry occurs, the hour number is
25 increased.

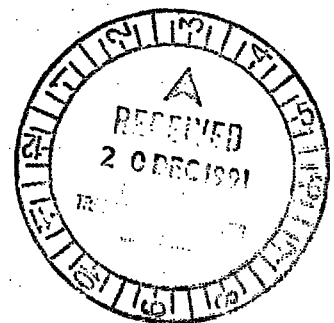
On the other hand, the output signal of the mode



setting circuit (103) which designates either the minute/hour adjustment mode or the date/month adjustment mode, is also inputted to AND gate (106), and causes the displayed number in the display window to flicker through the decoder (116) in accordance with the frequency (F_x) of the order of a few Hz. That is, the number displayed through the display window in the normal condition does not flicker, but the displayed number flickers in the adjustment mode.

On the other hand, the three state buffers (113, 114) and inverter (115) constituted to input selectively the output signal from the minute/hour counter (111), the date/month counter (112) to the decoder (116) are controlled by the output signal of the mode setting circuit (103). If the switch (SW1) does not provide an input for more than eight to nine seconds in the adjustment mode, the normal condition restore circuit (104) automatically resets the mode setting circuit (103) so as to restore the normal mode automatically. After the normal mode has been thus restored, if one inputs the switch (SW1) once, the second counter (110) is reset and is able to set the time correctly at the adjusted condition, and does not convert back to the adjustment mode. That is, second counter (110) is always reset every time the switch (SW1) is inputted once in the normal condition.

According to the above described method of controlling a digital liquid crystal timepiece, it is possible to achieve the conversion of the adjustment mode of the liquid crystal timepiece and also the
5 number increment operation using a single switch.



**CLAIMS:**

1. A method for controlling an adjustment mode conversion and for adjusting a time display of a digital timepiece, comprising the steps of:

5 selecting one of a plurality of adjustment modes associated with respective different time display components by operating a switch and entering the selected adjustment mode directly from normal time display of the timepiece; and

10 adjusting the time display component associated with the selected adjustment mode in accordance with further operation of the switch once an adjustment mode has been selected.

2. A method according to claim 1 wherein the
15 method further comprises the step of reverting to normal time display in response to inoperation of the switch for a predetermined duration while in a said adjustment mode.

3. A method according to claim 1 or claim 2
20 wherein the step of adjusting the time display component associated with the selected adjustment mode is accomplished at a rate which is variable in accordance with operation of the switch during said selected adjustment mode.

25 4. A control circuit for adjusting a digital time display in a timepiece wherein the circuit is



responsive to the operation of a manually operable element of the timepiece during normal time display to select between a plurality of adjustment modes associated with respective different time display components for direct entry from the normal time display to the selected adjustment mode, and wherein once a said mode has been selected, the circuit is responsive to further operation of the same said element to adjust the associated time display component.

5. A control circuit according to claim 4 wherein the control circuit is responsive to inoperation of said element for a predetermined duration while in a said adjustment mode to revert to normal time display.

6. A control circuit according to claim 4 or claim 5 wherein the time display component associated with the selected adjustment mode is adjusted at a rate which is variable in accordance with the further operation of the switch.

7. A method of controlling an adjustment mode conversion substantially as hereinbefore described with reference to Figures 1 to 3 of the drawings.

8. A control circuit substantially as hereinbefore described with reference to Figures 1 to 3 of the drawings.

