

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO ELECTRONIC WRIST WATCHES

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese company of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do hereby declare the invention, for which we

5 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:—

10 This invention relates to electronic wrist watches and more specifically to electronic wrist watches of the kind comprising a time-standard quartz crystal oscillator driving frequency dividing or counting circuits from which are derived signals for operating

15 a time-indicating electronic display device such, for example, as an LED display device, a liquid crystal display device, or a plasma type display device. In the interest of high reliability, miniaturisation and

20 economy of manufacture it is preferred, in watches of this kind, to employ, for the frequency dividing and other circuits by means of which the operating signals for the display device are obtained, integrated

25 COS/MOS circuits.

30 It is of course necessary, in watches of the kind referred to, to provide means for altering or correcting the displayed time and for re-setting certain of the circuits by means of which the display device operating signals are derived from the oscillations of the time-standard oscillator. The present invention is primarily concerned with these

35 altering and re-setting means and has for its main object to provide such means in a very convenient and easily manipulated form and of small size, so as to be neat and convenient for a wrist watch (where available space is very limited) and of high

40 reliability. In the preferred embodiments the said means are so arranged as, in practice, to preclude the possibility of their being unintentionally operated. In present day practice it is customary, whether the watch is an

45 electronic watch of the kind referred to or

a more conventional mechanical watch, to provide displayed time altering means and re-setting means on the side of the watch case. As will be seen later the present invention provides such means, in an electronic watch of the kind referred to, on the upper front side of the case that is to say on the face on which the time-indicating electronic display is given. This is, from the point of view of the user, the ideal arrangement.

According to this invention an electronic wrist watch comprises a time-standard quartz crystal oscillator; a time-indicating electronic display device; frequency dividing or counting circuits driven by said oscillator and adapted to derive, from the oscillatory output thereof operating signals for operating said electronic display device; and push-button operated switches for altering the displayed time, and for resetting certain of said circuits and arranged to be operated by push-buttons on the upper or front face of the watch case where the display device is situated.

The display device may be an LED device or a liquid crystal device or a plasma device, for example.

The watch circuits for deriving operating signals for the display device are preferably COS/MOS integrated circuits.

Mechanical locking means may be provided for preventing operation of the switches unless said locking means are first released or there may be provided electrical locking means for preventing operation of the switches from being effective unless said electrical locking means is operated.

Preferably the locking means, whether mechanical or electrical are operable by an additional push-button on the side of the watch case.

Preferably the display device displays hours and minutes in numeric manner and there are three time-adjusting buttons, one

[Price 25p]

Price 33p

for hours, one for tens of minutes and one for minutes arranged in the same order as that in which the hours, tens of minutes and minutes appear in the display.

- 5 Preferably all the switches are normally open switches.

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

- 10 Figure 1 is a perspective general arrangement view of a preferred wrist watch in accordance with the invention.

- 15 Figure 2 (which consists of two parts (a) and b)) illustrates a mechanical locking arrangement which may be used in a watch as illustrated by Figure 1.

Figure 3 illustrates an electronic locking arrangement which may be used in a watch as illustrated by Figure 1.

- 20 Figure 4 is a simplified block circuit diagram of the watch of Figure 1.

Figure 5 shows a resettable flip-flop having time adjusting circuits and suitable for use in a watch in accordance with Figures 1 and 4.

- 25 Figure 6 shows a detail modification of Figure 5 utilizing MOS transistors in place of resistors for supplying gate voltage.

- 30 Figure 1 is a general perspective view showing a wrist watch in accordance with this invention. In this figure, 1 is the wrist strap carrying the watch, 2 is the watch case, 3 is the digital time displaying panel or face of the watch, 4 are push-buttons for altering the displayed time, 5 is a divider setting push button, 6 is a start-stop push button, and 7 is a locking button. There are three displayed time altering buttons 4 and they are arranged (reading from left to right) to alter the hour figure and the tens of minutes and minute figures respectively. Buttons 4, 5 and 6 are on the front of the case 2, beneath the time display panel. The locking button 7 is on the side of the case 2. The arrangement of the buttons 4, 5 and 6 is very convenient for adjustment but, located in this manner, there is some risk that they may be accidentally or unintentionally operated when the watch is in wear. It is in order to prevent this that the locking button 7 is provided. This button serves to prevent such accidental or unintentional operation of the buttons 4 to 6. It may be arranged to provide locking action mechanically or electrically. The two parts of Figure 2 show, in schematic, mutually perpendicular views, an arrangement with mechanical locking. Figure 3 shows an arrangement with electrical locking.

- 60 Referring to Figure 2, the functional push-buttons 4, 5 and 6 are spring returned by a spring 9. Each time one of these buttons is pushed (assuming no locking) it performs its required function by closing a switch constituted by a spring contact 10

and a fixed contact 11. (There is of course a separate such switch for operation by each of the buttons 4 to 6). Locking is, however, provided by a longitudinally slidable shaft 77, moved endwise by the button 7, 70 and carrying stop discs 8 which, in the normal position of the button 7, are positioned beneath the buttons 4, 5 and 6 and prevent their being depressed. When the button 7 is depressed (against a return spring, not shown), the buttons 4, 5 and 6 become operable. There are, of course, other ways of securing mechanical locking. Thus, for example, each of the buttons 4, 5 and 6 may be so arranged that it must 80 be twisted (against a return spring) through a small angle before it can be pressed down. With an arrangement of this nature a separate locking button is, of course, not necessary.

85 Figure 3 shows an example of electrical locking. This figure shows switches, operated by the buttons 4, 5 and 6 and an additional locking switch operated by the button 7 and in a series circuit common to the other switches. So long as switch 7 is open, closure of any other switch is of no effect. Diodes are connected as shown in the individual circuits of switches 4, 5 and 6 to prevent mis-operation if more than one of the switches 4, 5 and 6 is closed at the same time. 95

Figure 4 is a block circuit diagram of the watch. In this figure *a* is a time standard quartz oscillator feeding into a divider *b* 100 which produces a 1 minute signal and is followed by a 1/10 divider and decoder *c* in turn followed by a 1/6 divider and decoder *d* in turn followed by a 1/24 divider and decoder *e*. The divider-decoders *c*, *d* 105 and *e* provide signals for operating the hour figures, the ten-minute figures and the minute figures of the time display of the watch and these operating signals are fed to the appropriate parts of the display arrangement 3 through buffer amplifiers *c'*, *d'*, and *e'*. The displayed time altering switches (actuated by buttons 4 in Figures 1 and 2) are referenced 4*a*, 4*b* and 4*c* in Figure 4 and are for time adjustment of the 115 hour, ten minute and minute displays. 5 is a system resetting switch which, when closed, resets all circuits, and 6 is a start-stop switch which, when operated resets only the divider *b*. 7 is the locking switch. During normal operation of the watch all the switches are open and gate voltage to controlling inverters (in circuits *c*, *d* and *e*) is supplied through circuits which are completed through resistors *R₁*, *R₂* and *R₃*. If 125 the displayed time is to be altered or circuits are to be reset, the locking switch 7 is first closed and then the appropriate other switch is operated.

Figure 5 illustrates in more detail the 130

nature of the resettable flip-flop and displayed time altering circuits employed. In normal use of the watch, switches 4 and 5 are open. (Only one of the switches 4 is shown in Figure 5; the others have similar circuits) with switch 4 open transmission gate T_1 is "on" and T_2 is "off" and input signals are accordingly supplied to flip-flop through T_1 . I_1 is a resetting control inverter the gate of which is connected to ground by resistor R_s , so that, in this condition, a common resetting line $\bar{R}$ adopts a "high" signal state and all the flip-flops are operated. If time is to be adjusted, input signals are produced by repeatedly opening and closing the switch 4. When the switch 4 is closed, transmission gate T_1 turns "off" and T_2 becomes "on". But the signal through T_2 is inverted by the inverter I_2 , so that an input signal to the flip-flop is produced at closing and opening of the switch 4. When the switch 5 is closed the flip-flop is reset to the zero state, because the gate voltage of inverter I_1 becomes "high" and the common resetting line $\bar{R}$ is set to ground voltage. V_{DD} is a supply voltage terminal.

Figure 6 illustrates a detail modification in which MOS transistors are utilized in place of the resistors shown in Figure 5. When the switch is open, the gate voltage of the inverter is grounded and the MOS transistor is "on". The output accordingly becomes "high". When, however, the switch is closed, the output becomes at ground voltage because the gate voltage of the inverter is increased to a predetermined high voltage. Circuitry of the nature of that of Figure 6 is preferable to that of Figure 5 because of its high reliability and ability to be incorporated in very small sizes. There being no resistances to be connected in circuit, construction in monolithic integrated circuit form is possible. Preferably the MOS transistors T employed are high impedance transistors in order that power consumption may be a minimum.

As will now be seen the invention provides a very convenient arrangement of controlling push buttons on the upper or front side of the watch case, so that displayed time alteration can be easily and correctly obtained by time-setting buttons for hour, ten-minute and minute adjustment, these buttons being in convenient and natural positions with respect to the figures they alter. If, as is preferred, locking (electrical or mechanical) is provided, risk of unintentional alteration or resetting is, for all practical purposes, eliminated. High reliability and small size are readily achievable and, moreover, there is the practical advantage that all the switches are normally open ones.

WHAT WE CLAIM IS:—

1. An electronic wrist watch comprising a time-standard quartz crystal oscillator; a time-indicating electronic display device; frequency dividing or counting circuits driven by said oscillator and adapted to derive, from the oscillatory output thereof operating signals for operating said electronic display device; and push-button operated switches for altering the displayed time, and for resetting certain of said circuits and arranged to be operated by push-buttons on the upper or front face of the watch case where the display device is situated.
2. A watch as claimed in claim 1 wherein the display device is an LED device.
3. A watch as claimed in claim 1 wherein the display device is a liquid crystal device.
4. A watch as claimed in claim 1 wherein the display device is a plasma device.
5. A watch as claimed in any of the preceding claims wherein said circuits are of the COS/MOS integrated circuit type.
6. A watch as claimed in any of the preceding claims wherein mechanical locking means are provided for preventing operation of the switches unless said locking means are first released.
7. A watch as claimed in any of claims 1 to 5 wherein there is provided electrical locking means for preventing operation of the watches from being effective unless said electrical locking means is operated.
8. A watch as claimed in claim 7 wherein the electrical locking means is constituted by an additional switch in a circuit in series with the circuits of the other switches.
9. A watch as claimed in claim 6 or 7 wherein the locking means are operable by an additional push-button on the side of the watch case.
10. A watch as claimed in any of the preceding claims wherein the display device displays hours and minutes in numeric manner and there are three displayed time-altering buttons, one for hours, one for tens of minutes and one for minutes arranged in the same order as that in which the hours, tens of minutes and minutes appear in the display.
11. A watch as claimed in any of the preceding claims wherein all the switches are normally open switches.
12. A watch as claimed in any of the preceding claims 1 to 6 having a push-button locking arrangement substantially as herein described with reference to the accompanying Figure 2.
13. A watch as claimed in any of claims 1 to 5, 7 and 8 having an electrical locking arrangement substantially as herein de-

nature of the resettable flip-flop and displayed time altering circuits employed. In normal use of the watch, switches 4 and 5 are open. (Only one of the switches 4 is shown in Figure 5; the others have similar circuits) with switch 4 open transmission gate T_1 is "on" and T_2 is "off" and input signals are accordingly supplied to flip-flop through T_1 . I_1 is a resetting control inverter the gate of which is connected to ground by resistor R_1 , so that, in this condition, a common resetting line $\bar{R}$ adopts a "high" signal state and all the flip-flops are operated. If time is to be adjusted, input signals are produced by repeatedly opening and closing the switch 4. When the switch 4 is closed, transmission gate T_1 turns "off" and T_2 becomes "on". But the signal through T_2 is inverted by the inverter I_2 , so that an input signal to the flip-flop is produced at closing and opening of the switch 4. When the switch 5 is closed the flip-flop is reset to the zero state, because the gate voltage of inverter I_1 becomes "high" and the

common resetting line $\bar{R}$ is set to ground voltage. V_{DD} is a supply voltage terminal.

Figure 6 illustrates a detail modification in which MOS transistors are utilized in place of the resistors shown in Figure 5. When the switch is open, the gate voltage of the inverter is grounded and the MOS transistor is "on". The output accordingly becomes "high". When, however, the switch is closed, the output becomes at ground voltage because the gate voltage of the inverter is increased to a predetermined high voltage. Circuitry of the nature of that of Figure 6 is preferable to that of Figure 5 because of its high reliability and ability to be incorporated in very small sizes. There being no resistances to be connected in circuit, construction in monolithic integrated circuit form is possible. Preferably the MOS transistors T employed are high impedance transistors in order that power consumption may be a minimum.

As will now be seen the invention provides a very convenient arrangement of controlling push buttons on the upper or front side of the watch case, so that displayed time alteration can be easily and correctly obtained by time-setting buttons for hour, ten-minute and minute adjustment, these buttons being in convenient and natural positions with respect to the figures they alter. If, as is preferred, locking (electrical or mechanical) is provided, risk of unintentional alteration or resetting is, for all practical purposes, eliminated. High reliability and small size are readily achievable and, moreover, there is the practical advantage that all the switches are normally open ones.

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2. A watch as claimed in claim 1 wherein the display device is an LED device.

3. A watch as claimed in claim 1 wherein the display device is a liquid crystal device.

4. A watch as claimed in claim 1 wherein the display device is a plasma device.

5. A watch as claimed in any of the preceding claims wherein said circuits are of the COS/MOS integrated circuit type.

6. A watch as claimed in any of the preceding claims wherein mechanical locking means are provided for preventing operation of the switches unless said locking means are first released.

7. A watch as claimed in any of claims 1 to 5 wherein there is provided electrical locking means for preventing operation of the watches from being effective unless said electrical locking means is operated.

8. A watch as claimed in claim 7 wherein the electrical locking means is constituted by an additional switch in a circuit in series with the circuits of the other switches.

9. A watch as claimed in claim 6 or 7 wherein the locking means are operable by an additional push-button on the side of the watch case.

10. A watch as claimed in any of the preceding claims wherein the display device displays hours and minutes in numeric manner and there are three displayed time-altering buttons, one for hours, one for tens of minutes and one for minutes arranged in the same order as that in which the hours, tens of minutes and minutes appear in the display.

11. A watch as claimed in any of the preceding claims wherein all the switches are normally open switches.

12. A watch as claimed in any of the preceding claims 1 to 6 having a push-button locking arrangement substantially as herein described with reference to the accompanying Figure 2.

13. A watch as claimed in any of claims 1 to 5, 7 and 8 having an electrical locking arrangement substantially as herein de-



scribed with reference to the accompanying Figure 3.

14. A watch as claimed in claim 1 connected and arranged substantially as herein described with reference to the accompanying Figure 4.

15. A watch as claimed in any of the preceding claims and having flip-flop time adjusting circuits substantially as herein described with reference to the accompanying Figure 5 or Figure 5 as modified by the accompanying Figure 6.

16. A watch as claimed in claim 1 substantially as herein described with reference to the accompanying Figure 1.

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