A watch having a liquid crystal display for the digital display of time in response to timing signals produced by divider and driving circuits, which in turn produce said timing signals in response to the high frequency time standard signal of a quartz crystal oscillator. A switch means is coupled to said driving circuits for rendering said liquid crystal display inoperative without disturbing said oscillator and divider circuit.

3 Claims, 4 Drawing Figures
WATCHES HAVING LIQUID CRYSTAL DISPLAYS

BACKGROUND OF THE INVENTION

This invention relates to watches incorporating liquid crystal display devices, and wherein a quartz crystal oscillator serves as a time standard. One defect in such watches is that liquid crystal displays have fairly short lives, about 5,000 to 7,000 hours, so that replacement of the liquid crystal display is required after only a short period of use.

Further, since about 15-30μW are required to drive liquid crystal displays and since small-sized batteries of limited capacity are incorporated in watches, the drain on the battery must be minimized to the extent possible so as to extend the life of the battery. If the battery of the watch has to be changed more often then about once a year, then the watch would not prove commercially practical.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, a watch is provided having a quartz oscillator for producing a high frequency time standard signal, divider and driving circuit means for producing timing signals in response to said high frequency time standard signal, liquid crystal display means for digitally displaying time in response to said timing signals, and switch means operatively coupled to said driving circuit means for rendering said liquid crystal display means inoperative without rendering said divider circuit means simultaneously inoperative.

The switch means may include a light detecting element for rendering said liquid crystal display inoperative upon the detection of less than a predetermined level of light by said light detecting element. Said driving circuit means may include inverter means having an output coupled to said liquid crystal display means and an input coupled to the output of a NAND gate. A first input of said NAND gate is coupled to said divider circuit means for receiving timing signals therefrom while a second input of said NAND gate is coupled to said switch means for application of a voltage thereto when said switch means is on, whereby said liquid crystal display means is operative only when said switch means is on.

Accordingly, it is an object of the invention to provide a fully electronic wrist watch including a digital display.

Another object of the invention is to provide means for extending the life of the liquid crystal displays incorporated in a watch.

A further object of the invention is to provide means for prolonging life of the battery in an electronic watch having a liquid crystal display.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification and drawings.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:
coupled to a photo-detecting element 11 mounted on the liquid crystal dial so as to automatically cut off the operation of the liquid crystal display segments in the presence of insufficient ambient light, irrespective of the setting of switch 10. Switch 10 is coupled through inverter 15 to photo-detecting element 11 and resistor 16, said resistor being in turn connected to a source. In effect, said photo-detecting element serves as the voltage source for one of the inputs to the NAND gates by bringing the input to inverter 15 to ground in the presence of a predetermined level of light to produce said voltage at the inputs to the NAND gates.

As more particularly shown in FIGS. 3a and 3b, the inverter and NAND circuits of the arrangement in accordance with the invention are preferably formed from COS/MOS transistors (metal oxide semiconductor transistors disposed in the complementary symmetry configuration). The inverter circuit in accordance with the invention formed from two MOS transistors is depicted in FIG. 3a, while the NAND circuit in accordance with the invention formed from four MOS transistors is depicted in FIG. 3b.

The foregoing arrangements insure that the liquid crystal display device is inoperative when the watch is not being used, or at night, when the liquid crystal display could not be read in any event. In this manner, the life of both the liquid crystal and the battery is extended, insuring the provision of a watch having a liquid crystal display which is commercially feasible.

It will thus be seen that the objects set forth above, and those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. In a watch having a time standard oscillator means for producing a high frequency signal; divider and driving circuit means for producing low frequency timing signals in response to said high frequency signal; and liquid crystal display means operative in response to said timing signals, the improvement which comprises switch means connected intermediate said liquid crystal display means and said driving circuit means for selectively rendering said liquid crystal display means inoperative without affecting the operation of said oscillator means and said divider circuit means, said switch means including inverter means having an output coupled to said liquid crystal display means and an input; NAND gate means having an output coupled to said inverter means and first and second inputs, a first of said inputs being coupled to said driving circuit means for receiving timing signals therefrom; and means for selectively applying a voltage to said NAND gate second input to render said liquid crystal display means operative in response to said timing signal when said voltage is applied to said NAND gate means second input and to render said liquid crystal means inoperative when said voltage is not so applied, said means for selectively applying said voltage including a light detecting element positioned to detect light applied to said liquid crystal display means, and means coupling said light detecting means and said NAND gate means second input for application of said voltage there to fore rendering said liquid crystal display means operative in response to said timing signal when a predetermined level of light is detected by said light detecting means.

2. A watch as recited in claim 1, wherein said liquid crystal display means is formed from a plurality of liquid crystal display segments, one of said NAND gate means and inverter means being connected to one electrode of each of said liquid crystal display segments, the other electrode of said liquid crystal display segments being connected in common, said light detecting means being connected between said common connection of said liquid crystal display segment electrodes and a common connection of the respective NAND gate means second input.

3. In a watch having a time standard oscillator means for producing a high frequency signal; divider and driving circuit means for producing low frequency timing signals in response to said high frequency signals; and liquid crystal display means disposed in a watch dial and operative in response to said timing means, the improvement which comprises switch means connected intermediate said liquid crystal display means and said driving circuit means for selectively rendering said liquid crystal display means inoperative without affecting the operation of said oscillator means and said divider circuit means, said switch means including a manually operable on and off switch, a photo-detecting element mounted on said watch dial, and circuit means interconnecting said switch means and photo-detecting element so that said liquid crystal display means is rendered operative in response to said timing signal, a predetermined setting of said manual switch and a predetermined level of light detected by said photo-detecting element.