

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) TIMEPIECE

(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 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 timepieces and, in particular, although not so restricted, to watches.

It is well known that the voltage for actuating a liquid crystal display element of a timepiece is between 20 volts and 40 volts, a voltage which is much higher than the voltage provided by the normal power source of the timepiece especially when the power source is a battery which produces a voltage of between 1.3 volts and 1.5 volts. The space available in a watch is so limited that it does not allow the use of several batteries to provide the voltage required to drive the liquid crystal display element.

According to the present invention there is provided a timepiece comprising: a vibrator for generating a time standard, a frequency divider circuit which produces a relatively low frequency signal from a relatively high frequency signal produced by oscillations of the vibrator, a liquid crystal display element, a circuit for producing a time indication signal from said relatively low frequency signal for display by the liquid crystal display element, and voltage increase means to produce from a relatively low voltage source a relatively high voltage to drive the liquid crystal display element.

Preferably, said voltage increase means comprises a transformer whose input voltage, in operation, comprises the voltage of a direct current source modulated by said relatively high frequency signal.

Said vibrator may be a tuning fork vibrator having a piezo electric driving element, the liquid crystal display element [Price 25p]

being connected between said driving element and said voltage increase means.

Alternatively, the vibrator may be a quartz crystal vibrator.

The invention is illustrated, merely by way of example, in the accompanying drawing which shows schematically a part of a timepiece according to the present invention.

Referring to the drawing a timepiece, e.g. a watch, according to the present invention comprises a tuning fork vibrator 1 for generating a time standard, a piezo electric element 2 for detecting oscillations of the vibrator, and a piezo electric element 3 for driving the vibrator. The timepiece includes a circuit comprising a base leak resistor 4, a diode 5 for bias adjustment, a transistor 6, a source 7 of direct current, a step-up transformer having coils 8, 9, a liquid crystal display element 10 and a switching transistor 11.

When the vibrator oscillates a relatively high frequency signal is produced by the piezo electric element 2 and a current flows to the base of the transistor 6. This current is amplified by the transistor 6 to produce an input voltage to the transformer across the coil 8. The output voltage of the transformer across the coil 9 is greater than the input voltage and is applied to the piezo electric element 3 to maintain oscillations of the vibrator.

The relatively high frequency signal from the piezo electric element 2 produced by oscillations of the vibrator is divided by means, which are not shown but which are conventional, to produce a relatively low frequency signal which is converted by a matrix circuit (also not shown) into a time indication signal 12 which is applied to the base of the transistor 11. The time indication signal 12 causes the transistor 11 to go into the conductive state so that the output voltage of the transformer is applied across

the liquid crystal display element 10 resulting in it giving a time display.

The present invention enables a watch having a liquid crystal display element to be
5 constructed. A relatively high voltage is needed to drive the liquid crystal display element and, in a watch, the source 7 of direct current is of a relatively low voltage, for example, it may be a mercury cell of 1.3
10 volts output and/or a silver cell of 1.5 volts output. A larger power source cannot be accommodated in the limited space of a watch and so it will be appreciated that the present invention provides the relatively
15 high voltage necessary to drive the liquid crystal display element by the transformer which steps up the relatively low voltage of the source 7 of direct current which voltage is modified by the oscillations of the
20 vibrator.

Instead of a tuning fork vibrator a quartz crystal vibrator may be used. When the vibrator is a tuning fork and is driven by the piezo electric element 3, the piezo electric element 3 requires a driving voltage of,
25 for example, 20 volts. Consequently, the output voltage of the transformer may be used to drive the piezo electric element 3. Thus the size of the transformer, which
30 otherwise would be relatively large, may be reduced and this may result in a commensurate reduction in the cost of the watch.

WHAT WE CLAIM IS:

35 1. A timepiece comprising: a vibrator for

generating a time standard, a frequency divider circuit which produces a relatively low frequency signal from a relatively high frequency signal produced by oscillations of the vibrator, a liquid crystal display element,
40 a circuit for producing a time indication signal from said relatively low frequency signal for display by the liquid crystal display element, and voltage increase means to produce
45 from a relatively low voltage source a relatively high voltage to drive the liquid crystal display element.

2. A timepiece as claimed in claim 1 in which said voltage increase means comprises a transformer whose input voltage, in operation,
50 comprises the voltage of a direct current source modulated by said relatively high frequency signal.

3. A timepiece as claimed in claim 1 or 2 in which said vibrator is a tuning fork
55 vibrator having a piezo electric driving element, the liquid crystal display element being connected between said driving element and said voltage increase means.

4. A timepiece as claimed in any preceding claim in which the vibrator is a quartz
60 crystal vibrator.

5. A timepiece substantially as herein described with reference to and as shown in the accompanying drawing.
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Instead of a tuning fork vibrator a quartz crystal vibrator may be used. When the vibrator is a tuning fork and is driven by the piezo electric element 3, the piezo electric element 3 requires a driving voltage of, for example, 20 volts. Consequently, the output voltage of the transformer may be used to drive the piezo electric element 3. Thus the size of the transformer, which otherwise would be relatively large, may be reduced and this may result in a commensurate reduction in the cost of the watch.

WHAT WE CLAIM IS:

1. A timepiece comprising: a vibrator for

generating a time standard, a frequency divider circuit which produces a relatively low frequency signal from a relatively high frequency signal produced by oscillations of the vibrator, a liquid crystal display element, a circuit for producing a time indication signal from said relatively low frequency signal for display by the liquid crystal display element, and voltage increase means to produce from a relatively low voltage source a relatively high voltage to drive the liquid crystal display element.

2. A timepiece as claimed in claim 1 in which said voltage increase means comprises a transformer whose input voltage, in operation, comprises the voltage of a direct current source modulated by said relatively high frequency signal.

3. A timepiece as claimed in claim 1 or 2 in which said vibrator is a tuning fork vibrator having a piezo electric driving element, the liquid crystal display element being connected between said driving element and said voltage increase means.

4. A timepiece as claimed in any preceding claim in which the vibrator is a quartz crystal vibrator.

5. A timepiece substantially as herein described with reference to and as shown in the accompanying drawing.

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