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(54) ELECTRONIC TIMEPIECES

(71) We, KABUSHIKI KAISHA SUWA SEICOSHA, a Japanese body corporate, 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 electronic timepieces, for example, electronic wrist watches.

According to the present invention there is provided an electronic timepiece comprising: an oscillator circuit for producing a standard time signal; a divider circuit, the oscillator circuit and the divider circuit being arranged to be powered by a relatively low DC voltage from a battery; a display circuit; a driving circuit for receiving an output of the divider circuit and for driving the display circuit, the display circuit and the driving circuit being arranged to be powered by a relatively high DC voltage; converting means for producing a relatively high AC voltage from the said relatively low DC voltage; and a rectifier circuit for producing the relatively high DC voltage from the relatively high AC voltage, the rectifier circuit and the driving circuit being of integrated circuit construction and formed on the same base.

Preferably the converting means comprises a DC/AC converter circuit and a voltage booster circuit.

The timepiece may be in combination with a battery, the battery being connected to supply the low DC voltage to the oscillator circuit, the divider circuit and the DC/AC converter circuit.

Preferably the oscillator circuit includes a quartz crystal vibrator.

The display circuit may include liquid crystal elements.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which: —

Figure 1 is a block diagram of a timepiece conventional in Japan; and

Figure 2 is a block diagram of an electronic timepiece according to the present invention.

In the drawings the direction and flow of power is indicated by single arrows and the direction and flow of signals is indicated by double arrows.

Referring first to Figure 1, there is shown an electronic timepiece, for example a wrist watch, conventional in Japan and having an oscillator circuit 2 including a quartz crystal vibrator (not shown) for producing a relatively high frequency standard time signal, and a divider circuit 3 for converting the relatively high frequency standard time signal into a relatively low frequency standard time signal. Both the oscillator circuit 2 and the divider circuit 3 are powered by a relatively low DC voltage, for example, 1.5 volts, from a battery 1.

The relatively low frequency standard time signal from the divider circuit 3 is supplied to a driving circuit 4 which further divides the relatively low frequency standard time signal to produce a driving signal which is supplied to a display circuit 5 composed of liquid crystal elements (not shown). Both the driving circuit 4 and the display circuit 5 are powered by relatively high DC voltage, that is to say a DC voltage greater than that produced by the battery 1.

In an electronic wrist watch a separate battery cannot be provided to produce this relatively high DC voltage because of lack of space to house it and because it would almost inevitaly have a different operational lifetime from the battery 1. Conventionally, therefore, the relatively low DC voltage of

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the battery 1 is transformed to produce the relatively high DC voltage required to power the driving circuit 4 and the display circuit 5. To this end a DC/AC converter circuit 6, a voltage booster circuit 7 and a rectifier circuit 8 are provided. The relatively low DC voltage from the battery 1 is converted to a relatively low AC voltage by the converter circuit 6 and a relatively high AC voltage is produced therefrom by the voltage booster circuit 7. This relatively high AC voltage is rectified in the rectifier circuit 8 to produce the relatively high DC voltage which is then supplied to both the driving circuit 4 and the display circuit 5 to power them.

Whilst conventionally the divider circuit 3 and the driving circuit 4 may be of integrated circuit construction each being on a respective single base plate, the converter circuit 6, the voltage booster circuit 7 and the rectifier circuit 8 are conventionally assembled from individual components and consequently these circuits as a whole occupy a relatively large space, are difficult to manufacture and have a tendency to be unreliable.

Figure 2 is a block diagram of an embodiment of an electronic timepiece, for example, a wrist watch, according to the present invention. Like parts in Figures 1 and 2 have been designated by the same reference numbers and so will not be described further in detail.

The converter circuit 6 and the voltage booster circuit 7, which are difficult to make of integrated circuit construction, are made conventionally, that is to say, assembled from individual components. However, the rectifier circuit and the driving circuit are combined into a single driving/rectifier circuit 9 which is of integrated circuit construction being mounted on the same base which may be a base plate.

For a wrist watch, the current consumption of the display circuit 5 and the driving circuit for driving the same is only several micro-amperes. A rectifier circuit of relatievly high efficiency can be made using diodes having a comparatively small junction area. Consequently, the driving/rectifier circuit 9 may be produced with a similar chip area and at a similar cost to the conventional driving circuit 4.

In place of the display circuit 5 composed of liquid crystal elements, a display circuit composed of ferroelectric elements may be employed.

The present invention can be applied to any electronic timepiece wherein a circuit which has a current consumption of not more than several micro-amperes is driven by relatively high DC voltages which is obtained by converting a relatively low DC voltage to a relatively low AC voltage, by transforming the relatively low AC voltage to produce a relatively high AC voltage and by subsequently rectifying the relatively high AC voltage to produce a relatively high DC voltage.

WHAT WE CLAIM IS:—

1. An electronic timepiece comprising: an oscillator circuit for producing a standard time signal; a divider circuit, the oscillator circuit and the divider circuit being arranged to be powered by a relatively low DC voltage from a battery; a display circuit; a driving circuit for receiving an output of the divider circuit and for driving the display circuit, the display circuit and the driving circuit being arranged to be powered by a relatively high DC voltage; converting means for producing a relatively high AC voltage from the said relatively low DC voltage; and a rectifier circuit for producing the relatively high DC voltage from the relatively high AC voltage, the rectifier circuit and the driving circuit being of integrated circuit construction and formed on the same base.

2. A timepiece as claimed in claim 1 in which the converting means comprises a DC/AC converter circuit and a voltage booster circuit.

3. A timepiece as claimed in claim 2 in combination with a battery, the battery being connected to supply the low DC voltage to the oscillator circuit, the divider circuit and the DC/AC converter circuit.

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

5. A timepiece as claimed in any preceding claim in which the display circuit includes liquid crystal elements.

6. An electronic timepiece substantially as herein described with reference to and as shown in Figure 2 of the accompanying drawings.

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Whilst conventionally the divider circuit 3 and the driving circuit 4 may be of integrated circuit construction each being on a respective single base plate, the converter circuit 6, the voltage booster circuit 7 and the rectifier circuit 8 are conventionally assembled from individual components and consequently these circuits as a whole occupy a relatively large space, are difficult to manufacture and have a tendency to be unreliable.

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In place of the display circuit 5 composed of liquid crystal elements, a display circuit composed of ferroelectric elements may be employed.

The present invention can be applied to any electronic timepiece wherein a circuit which has a current consumption of not more than several micro-amperes is driven by relatively high DC voltages which is obtained by converting a relatively low DC voltage to a relatively low AC voltage, by transforming the relatively low AC voltage to produce a relatively high AC voltage and by subsequently rectifying the relatively high AC voltage to produce a relatively high DC voltage.

WHAT WE CLAIM IS:—

1. An electronic timepiece comprising: an oscillator circuit for producing a standard time signal; a divider circuit, the oscillator circuit and the divider circuit being arranged to be powered by a relatively low DC voltage from a battery; a display circuit; a driving circuit for receiving an output of the divider circuit and for driving the display circuit, the display circuit and the driving circuit being arranged to be powered by a relatively high DC voltage; converting means for producing a relatively high AC voltage from the said relatively low DC voltage; and a rectifier circuit for producing the relatively high DC voltage from the relatively high AC voltage, the rectifier circuit and the driving circuit being of integrated circuit construction and formed on the same base.

2. A timepiece as claimed in claim 1 in which the converting means comprises a DC/AC converter circuit and a voltage booster circuit.

3. A timepiece as claimed in claim 2 in combination with a battery, the battery being connected to supply the low DC voltage to the oscillator circuit, the divider circuit and the DC/AC converter circuit.

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

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