

11 / TIM 75
Singapore

PATENT SPECIFICATION

(11) 1 349 096

1 349 096

- (21) Application No. 51415/71 (22) Filed 4 Nov. 1971
(31) Convention Application No. 87215 (32) Filed 5 Nov. 1970 in (19)
(33) United States of America (US)
(44) Complete Specification published 27 March 1974
(51) International Classification G04C 17/00//H02M 3/32; H03K 3/282
(52) Index at acceptance

H2F 3E2T1 3E2V 3EY 9B1 9J6 9N1B2 9N1B3 9N2A 9R4B
9R4C 9R8B 9SX 9T2 9T5

G3T A5X

H3T 1G1 2J 2T3J 4C 4D 4E2N 4M 4R 5E



(54) ELECTRICALLY OPERATED WATCH HAVING MEANS FOR INCREASING THE POWER SUPPLY VOLTAGE

(71) We, TIMEX CORPORATION, a Corporation organised under the laws of the State of Delaware, United States of America, of Waterbury 20, Connecticut, United States of America, 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:—

The present invention relates to horology and more particularly to a watch.

In conventional electric or electronic watches, the power supply comprises an energy cell having an output voltage of about 1.5 volts. Higher power levels require either additional cells or larger cell arrangements. Since space is a prime consideration in watch design, it is highly undesirable to select either of the aforementioned alternatives and yet present and future solid state watches will require higher voltages. With a voltage of about 5 volts or more, MOS techniques can be used for all circuits and solid state indicating systems are feasible. Furthermore, piezoelectric motors and alarm systems having voltage inputs of 5 to 30 volts may be employed.

Accordingly, it is an object of this invention to provide a mechanical, electrical or electronic watch driven by a voltage higher than that of the power supply.

According to the present invention there is provided a watch comprising: a low voltage power supply, means connected to the low voltage power supply and driven thereby to provide a series of pulses, means for increasing the voltage of the pulses for providing a higher voltage output, and means driven by the higher voltage output from the voltage increasing means to indicate time.

Preferred embodiments of the present invention provide an electric or electronic watch comprising an oscillator providing a predetermined frequency which is used to

operate a DC—AC converter or chopper, for changing the oscillator output to AC pulses, the AC pulses being then transformed or multiplied to a higher voltage level. The higher voltage level achieved, still using a conventional 1.5 volt low voltage energy cell, permits the use of MOS circuitry, liquid crystal displays, light emitting diode displays and various solid state indicating systems. Also piezoelectric components may be used for motors and alarms which require a voltage in the order of 5 to 30 volts. More accurate oscillators can be built by eliminating the voltage limitation which presented a problem heretofore.

The invention will now be further described with reference to the accompanying drawings wherein:—

Figure 1 is a block diagram of a first embodiment of the invention;

Figure 2 is a block diagram of a second embodiment of the invention;

Figure 3 is a circuit drawing of the first embodiment of the invention disclosed in Figure 1 showing in detail portions thereof;

Figure 4 is a circuit drawing illustrating portions of the second embodiment of the invention disclosed in Figure 2 in greater detail;

Figure 5 shows the alternately polarized DC signals which are fed to the input of the voltage multiplier of Figure 1; and

Figure 6 shows the DC pulse output wave forms from the chopper of Figure 2.

As shown in Figure 1, a watch comprises a power supply 10 such as a conventional energy cell which furnishes 1.5 volts to an oscillator 11. The oscillator 11, which may be a balance wheel and switch arrangement or an electronic oscillatory circuit supplies a predetermined frequency to a DC—AC converter 12 for changing the oscillator output to AC pulses. The AC output (alternately polarized DC output) of the converter 12 is fed to a voltage multiplier 14 which

may be of the type disclosed in United States Patent No. 3,295,047 to provide a higher voltage.

5 The voltage is multiplied in each stage of the multiplier 14 and changed from an AC voltage to a higher DC voltage. The output is a function of the number of multiplier stages used and the 1.5 volt input could be increased to 3 volts, to 6 volts, or to
10 higher values. The output voltage is raised to a level sufficient to operate an indicating system or motor 16 which requires a higher DC voltage than that furnished by the 1.5 volt energy cell 10. If a motor or indicator 26 is used which requires an AC input a DC—AC converter 29 may be connected between
15 multiplier 14 and motor 26.

In Figure 2, an oscillator 9 and a chopper 13 convert DC from a power supply 8 into DC pulses, see Figure 6. The pulses are transformed into a higher AC voltage in a transformer 17 and, if necessary, rectified by rectifier 15 to a predetermined DC voltage. This voltage is fed to an indicating system or motor 18 which may be a MOS circuit, a solid state display or a piezoelectric motor. On the other hand, the output of transformer 17 may be fed directly to a motor or indicating system 27 compatible with the AC output.
30

Figure 3 shows the power supply 10, the oscillator 11, converter 12 and voltage multiplier 14 of Figure 1 in greater detail. The oscillator is connected to the DC—AC converter 12 and then to a cascade doubler stage of the voltage multiplier 14. The oscillator is formed by transistors 30 and 31 which function as a multivibrator in combination with capacitors 32 and 33 and timing resistors 34 and 36. In operation, with 31 initially saturated, 30 is cut off. After a predetermined period of time t_2 , transistor 30 saturates as a function of the timing circuit, capacitor 33 and resistor 36, while transistor 31 is driven to cut off. After a period of time t_1 , transistor 31 saturates as a function of the timing circuit including capacitor 31 and resistor 34, transistor 30 becomes cut off. The multivibrator continues to function at a frequency determined by the timing circuits resistor 34 — capacitor 32 and resistor 36 — capacitor 33.
45

Pulses from transistors 30 and 31 control a DC—AC converter comprising transistor 38, 41, 43 and 44.
50

When transistor 31 saturates, the base 37 of transistor 38 becomes negative and transistor 38 saturates. The base 39 of transistor 41 becomes positive and transistor 41 also becomes saturated. At the same time, the base 42 of transistor 30 becomes negative and cuts off which in turn cuts off transistors 43 and 44. Current flows from the positive terminal of the battery 10 through transistor 38 and the load through transistor 41 back to
55

the battery's negative terminal.

After the time t_2 , transistor 30 saturates as well as transistor 43 and 44 and transistor 31, 38, and 41 are cut off. Current flows in the opposite direction from the positive battery terminal through transistor 44 and load and through transistor 43, back to the negative battery terminal. This AC output, see Figure 5, is fed to the voltage multiplier 14 which multiplies the voltage in each stage, for example, 3 volts, 6 volts, etc. and converts the AC voltage to a higher DC voltage. The main circuit elements, in general, are standard units so further discussion is not necessary.
70

Figure 4 discloses in greater detail a portion of the second embodiment of the invention involving a self-oscillating chopper 13 connected to a transformer 17 and possibly a rectifier 15. The chopper 13 converts DC into DC pulses, as shown in Figure 6, which are then transformed to a high AC voltage in the transformer 17 and rectified to the predetermined DC voltage if desired as shown in dotted line.
75

Since the circuit elements of Figure 4 are conventional, only a brief description of their operation will be given. Accordingly, when transistor 50 is saturated, current flows through a primary winding 52 of the transformer 17. The current builds up a magnetic field in the ferrite core of the transformer 17 which induces a negative voltage in the transformer coupled feed back winding 53 and eventually shuts off the transistor 50. The current through winding 52 and the magnetic field cease. The cycle then repeats. The current pulses in winding 52 are transformed to a high voltage in the secondary winding 56. While Figure 4 shows one type of chopper circuit, many other types of choppers and oscillators can be used for this invention.
80

It is also to be noted that depending upon the circuit requirement, it may be possible to combine various portions of the circuits shown in Figures 1 and 2. For example, the output of the converter 12 in Figure 1 could be fed to the transformer 17 of Figure 2, the remainder of the circuit staying the same. On the other hand, the output of the chopper, transformer 13, 17 of Figure 2 could be fed to the voltage multiplier 14 of Figure 1 with the rest of the circuit remaining the same.
85

The invention as thus described above opens new vistas in watch design permitting the use of new technologies within the stringent space limitations of a watch. These new technologies and components generally require high voltages which have not been available heretofore. The power supply provides a voltage capable of operating highly efficient quartz oscillators circuits and dividing units, solid state indicating
90

systems, liquid crystals, piezoelectric and electro-static motors and piezoelectric alarm systems, and associated systems, in mechanical, electrical and electronic watches.

WHAT WE CLAIM IS:—

1. A watch comprising: a low voltage power supply, means connected to the low voltage power supply and driven thereby to provide a series of pulses, means for increasing the voltage of the pulses for providing a higher voltage output, and means driven by the higher voltage output from the voltage increasing means to indicate time.

2. A watch in accordance with Claim 1 wherein the pulse-providing means comprises an oscillator and a DC—AC converter for changing the oscillator output to AC pulses, and the voltage increasing means comprises a voltage multiplier.

3. A watch in accordance with Claim 2 including a further DC—AC converter connected between the voltage multiplier and the driven means to provide higher

voltage AC to the driven means.

4. A watch in accordance with Claim 1 wherein the pulse-providing means comprises a chopper providing DC pulses, and the voltage increasing means comprises a transformer.

5. A watch in accordance with Claim 4, wherein a rectifier is connected to the transformer output to provide a DC to the driven means.

6. A watch in accordance with Claim 2 or Claim 3, wherein the voltage multiplier comprises a plurality of cascaded doubler stages, and the oscillator is a multivibrator.

7. A watch in accordance with any one of the preceding claims, wherein the driven means comprises a watch motor or display.

8. A watch substantially as hereinbefore described with reference to Figures 1, 3 and 5 or Figures 2, 4 and 6 of the accompanying drawings.

STEVENS, HEWLETT & PERKINS,
Chartered Patent Agents,
5, Quality Court, Chancery Lane,
London, WC2A 1HZ.

5 systems, liquid crystals, piezoelectric and electro-static motors and piezoelectric alarm systems, and associated systems, in mechanical, electrical and electronic watches.

WHAT WE CLAIM IS:—

10 1. A watch comprising: a low voltage power supply, means connected to the low voltage power supply and driven thereby to provide a series of pulses, means for increasing the voltage of the pulses for providing a higher voltage output, and means driven by the higher voltage output from the voltage increasing means to indicate time.

15 2. A watch in accordance with Claim 1 wherein the pulse-providing means comprises an oscillator and a DC—AC converter for changing the oscillator output to AC pulses, and the voltage increasing means comprises a voltage multiplier.

20 3. A watch in accordance with Claim 2 including a further DC—AC converter connected between the voltage multiplier and the driven means to provide higher

voltage AC to the driven means.

4. A watch in accordance with Claim 1 wherein the pulse-providing means comprises a chopper providing DC pulses, and the voltage increasing means comprises a transformer.

5. A watch in accordance with Claim 4, wherein a rectifier is connected to the transformer output to provide a DC to the driven means.

6. A watch in accordance with Claim 2 or Claim 3, wherein the voltage multiplier comprises a plurality of cascaded doubler stages, and the oscillator is a multivibrator.

7. A watch in accordance with any one of the preceding claims, wherein the driven means comprises a watch motor or display.

8. A watch substantially as hereinbefore described with reference to Figures 1, 3 and 5 or Figures 2, 4 and 6 of the accompanying drawings.

STEVENS, HEWLETT & PERKINS,
Chartered Patent Agents,
5, Quality Court, Chancery Lane,
London, WC2A 1HZ.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1974.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

