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(54) AN ELECTRIC WRISTWATCH

(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 electric wrist-watches.

According to the present invention there is provided an electric wristwatch including a sealed re-chargeable battery having an electrolyte which either comprises sodium hydroxide or includes sodium hydroxide as the principal constitute and anodic material which either comprises zinc amalgam or includes zinc amalgam as the principal constituents.

Preferably the wristwatch includes charging

means connected to charge the battery.

The charging means may be a photo-electric converter, a mechanical-electric converter, e.g. a magnetic-electric converter, an electric-electric converter, or a thermo-electric generator.

One conventional small sized alkaline secondary or re-chargeable battery uses an electrolyte of potassium hydroxide. However such a battery deteriorates fairly quickly compared with a similar battery using sodium hydroxide as an electrolyte. The following table compares the characteristics of a conventional battery with a potassium hydroxide electrolyte and a battery of an electric wrist-watch according to the present invention with a sodium hydroxide electrolyte. Both batteries include a zinc amalgam as anodic material and in which there is a separator.

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TABLE

Electrolyte Performance	Sodium hydroxide	Potassium hydroxide
Leak-resistance	O	x
Self-discharge rate	O	x
Deterioration of separator	O	x
Low-temperature characteristic	Δ	O
Capacitance	Δ	O
Output current	Δ	O
Charging rate	Δ	O
Charge-discharge cycle	O	x

O...superior

x...inferior

Δ...rather inferior

Whilst the above table applies to the case where the batteries are used as secondary of re-chargeable batteries, it is also relevant to the case where the batteries are primary, or non-re-chargeable batteries except for the charging characteristics. A sodium hydroxide electrolyte is generally used in a non-re-chargeable battery of a wristwatch. A potassium hydroxide electrolyte is used in a non-re-chargeable battery of certain timepieces where a relatively large output current is required, such a non-re-chargeable battery being exchanged every one or one and a half years.

Conventionally, re-chargeable batteries are replaced every three years or so, this useful life being less than the useful life of the wristwatch. Since the creep characteristics of a potassium hydroxide electrolyte is more pronounced than that of a sodium hydroxide electrolyte, leaks occur more easily in batteries using potassium hydroxide electrolytes.

In the present invention a sealed re-chargeable battery having an electrolyte which is either composed of sodium hydroxide or includes sodium hydroxide as the principal constituent, and anodic material which either comprises zinc amalgam or includes zinc amalgam as the principal constituent is used

in a wristwatch. It has been shown by experiment that the output current and charging rate disadvantages of re-chargeable batteries having a sodium hydroxide electrolyte may be covered in this invention on the basis of the actual measurement of the charging means. Furthermore, the suitability of sodium hydroxide as an electrolyte in a re-chargeable battery wristwatch is shown by accelerated deterioration tests under heat and accelerated charging and discharging tests.

As a result, a wristwatch having a re-chargeable battery is practical although such a wristwatch cannot be made conventionally because there is no small-sized high-performance re-chargeable battery currently in existence. Wristwatches according to the present invention have been tested so far for three years. These wristwatches have re-chargeable batteries charged by a solar battery as the charging means. The charging means may, however, be a photo-electric converter, a mechanical-electric converter, e.g. a magnetic-electric converter, an electric-electric converter or a thermo-electric generator. No difficulties, such as leakage have occurred and accelerated tests guarantee good operation of the battery for at least 10 years. On the other

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hand, a re-chargeable battery having a potassium hydroxide electrolyte leaks within the life-time of the wristwatch and such leaks corrode connecting terminals of the re-chargeable battery and have an undesirable influence on the watch movement. Thus a potassium hydroxide electrolyte is not practical in a re-chargeable battery of a wristwatch.

A wristwatch according to the present invention may thus incorporate a small-sized high-performance re-chargeable battery for its relatively low discharge whilst conventionally a re-chargeable battery having a potassium hydroxide electrolyte was used chiefly for its charging characteristics i.e. especially rapid charging rate. Thus wristwatches according to the present invention may have an improved operational life compared to conventional wristwatches.

20 WHAT WE CLAIM IS:—

1. An electric wristwatch including a sealed re-chargeable battery having an electrolyte which either comprises sodium hydroxide or includes sodium hydroxide as the principal constituent and anodic material which either comprises zinc amalgam or includes zinc amalgam as the principal constituent.

2. A wristwatch as claimed in claim 1 including charging means connected to charge the battery.

3. A wristwatch as claimed in claim 2 in which the charging means is a photo-electric converter.

4. A wristwatch as claimed in claim 2 in which the charging means is a mechanical-electric converter.

5. A wristwatch as claimed in claim 4 in which the mechanical-electric converter is a magnetic-electric converter.

6. A wristwatch as claimed in claim 2 in which the charging means is an electric-electric converter.

7. A wristwatch as claimed in claim 2 in which the charging means is a thermo-electric generator.

8. An electric wristwatch substantially as herein described.

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5. A wristwatch as claimed in claim 4 in which the mechanical-electric converter is a magnetic-electric converter.

6. A wristwatch as claimed in claim 2 in which the charging means is an electric-electric converter.

7. A wristwatch as claimed in claim 2 in which the charging means is a thermo-electric generator.

8. An electric wristwatch substantially as herein described.

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