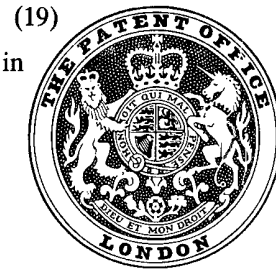


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(54) ELECTRIC CLOCKS

(71) We, LGZ LANDIS & GYR ZUG AG, a body corporate organised and existing under the laws of Switzerland, of CH-6301 Zug, Switzerland, 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 clocks.

Electric clocks are used in many fields where precision timing is required, for example in time switching means of electricity meters. Modern electronic time switch clocks with low current consumption comprise a timing signal generator, such as a quartz crystal controlled oscillator, a frequency divider, a switching circuit and, controlled thereby, a synchronous or stepping motor which drives the actual time switch.

It is known from German Offenlegungsschriften 24 20 489 and 24 32 196 to supply clocks of this type with rectified mains current, and from a rechargeable battery which forms a stand-by connected directly into the dc supply circuit for a frequency divider and a switching circuit. The purpose of this is to ensure that the clock will operate satisfactorily for a period determined by the capacity of the battery and the current consumption, even if the mains supply fails. A reserve of this type amounts in one particular clock to 18 days, while approximately 2½ days are required to recharge the battery fully with a charging current of approximately 6 mA. Thus it may happen that, when such a clock is connected to mains with a fully discharged battery, the individual stages of the frequency divider assume any state and the end stage of the switching circuit therefore connects through before the oscillator starts oscillating. Owing to the continuous loading of the dc supply portion as a result of the current flowing through the motor, charging of the battery is prevented, with the result that the clock cannot subsequently

start up.

According to the present invention there is provided an electric clock comprising means for rectifying an *ac* input to provide a first *dc* supply, a rechargeable battery for providing an alternative *dc* supply and connected to be recharged by said first *dc* supply, a motor, an oscillator, frequency divider and switching circuit for developing a signal to drive said motor, and means to decouple the *dc* feed to said oscillator and said frequency divider from the *dc* feed to said battery and said switching circuit.

The invention will now be described by way of example with reference to the accompanying drawing, the single figure of which shows the circuit of a clock according to the present invention.

The clock comprises a *dc* supply portion 1, an oscillator and frequency divider arrangement 2, a switching circuit 3 and a stepping (or synchronous) motor 4 driven by pulses from the switching circuit 3. The *dc* current supply portion 1 has terminals 5, 6 and 7 for two different *ac* voltage ranges. A resistor 8 connects the terminals 6 and 7.

A bridge rectifier 11 is connected to the terminals 5 and 6 via two identical resistors 9 and 10. A *dc* supply lead 12 of the rectifier 11 supplies a smoothing capacitor 13 and the oscillator and frequency divider arrangement 2 with positive *dc* voltage. A resistor 14 limits the charging current for the capacitor 13.

A further resistor 15 connects the *dc* supply lead 12 to the positive terminal of a rechargeable battery 16, preferably an Ni/Cd battery, the negative terminal of which is coupled to the negative output terminal of the rectifier 11. A lead 17 forms the link between the oscillator and frequency divider arrangement 2, the switching circuit 3, the motor 4 and the capacitor 13, on the one hand, and the negative output terminal of the rectifier 11. A diode 18, poled as

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shown, is connected in parallel with the resistor 15 to the *dc* supply lead 12 which carries positive voltage. This is particularly advantageous when operating at relatively low mains voltages.

The circuit is designed for two ranges of mains voltage. Terminals 5 and 6 are intended for example for the 100 to 130 volt range and terminals 5 and 7 for the 200 to 260 volt range. The series resistor 8 is therefore selected so that the voltage of the higher range is reduced to the lower range under the normal load.

The circuit operates as follows:

The *ac* voltage at terminals 5 and 6 is reduced by the resistors 9 and 10 to an appropriate low voltage which is supplied to the rectifier 11. At least one of the resistors 9 and 10 could be replaced by a suitable capacitor, thereby decreasing the power loss. The positive output terminal of the rectifier 11 is connected to the *dc* supply lead 12, which supplies an operating voltage via the resistor 14 to the capacitor 13 and the oscillator and frequency divider arrangement 2. When the clock is mains operated this *dc* potential may for example be from 1.4 to 2.0 volts, and when operated exclusively with the battery 16 approximately 1.2 to 1.4 volts. In either case the potential relative to the lead 17 which is at a negative potential, ensures that the oscillator will definitely start oscillating and the frequency divider definitely function in the arrangement 2, before the motor 4 can start. With mains operation the positive *dc* voltage is supplied to the battery 16 via the resistor 15, with stabilisation by the diode 18. In this way the maximum *dc* voltage of the rectifier 11 occurring during mains operation is reduced at the battery 16 to the 1.4 volts required for charging it. A virtually constant *dc* flows through the resistor 15, diode 18 and battery 16. This current ensures that the battery 16 is always in the charged state or is recharged immediately after a mains failure. The *dc* voltage of the battery 16 enables the motor 4 to operate via its switching circuit 3, which may, for example, be in accordance with our Swiss patent no 580 297. A switching circuit of this type virtually doubles the voltage for the switching pulse of the stepping motor 4.

The switching circuit 3 is preferably not an integrated circuit, the reason for this being that, by using a braking transistor and a diode in parallel with the motor 4, a clean braking action can be obtained in known manner after the switching pulse has died away.

If the mains fails, the oscillator and frequency divider arrangement 2, which consumes only a little current, is fed with virtually the voltage of the battery 16. It comes into action after a short time lag brought about by the RC network comprising capacitor 13 and resistor 14. Thus the clock

can operate satisfactorily for a long period, even during an interruption of the mains voltage; and even if the battery 16 has run down, which happens only seldom, the oscillator and frequency divider arrangement 2 starts again and continues to operate immediately the mains voltage is restored, while the time lag for the motor 4 is longer owing to the RC network comprising capacitor 13 and resistors 14 and 15.

WHAT WE CLAIM IS:

1. An electric clock comprising means for rectifying an *ac* input to provide a first *dc* supply, a rechargeable battery for providing an alternative *dc* supply and connected to be recharged by said first *dc* supply, a motor, an oscillator, frequency divider and switching circuit for developing a signal to drive said motor, and means to decouple the *dc* feed to said oscillator and said frequency divider from the *dc* feed to said battery and said switching circuit.

2. A clock according to claim 1 wherein said decoupling means is a resistor.

3. A clock according to claim 2 wherein a diode is connected in parallel with said resistor, said diode being poled to enable current to flow to said battery.

4. A clock according to claim 1 wherein said rectifying means is a bridge rectifier, which is connected by means of at least one resistor and/or by means of at least one capacitor to input terminals to which said *ac* input is supplied.

5. A clock according to claim 1 wherein said motor is a stepping motor connected to said battery via said switching circuit which doubles the voltage of pulses supplied to said motor.

6. An electric clock substantially as hereinbefore described with reference to the accompanying drawing.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of
the Original on a reduced scale*

