

# PATENT SPECIFICATION

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## (54) ELECTRIC TIMEPIECE

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, 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:—

The invention relates to electric timepieces.

According to the present invention there is provided an electric timepiece including a driving motor having a stator and a rotor, and a stem yoke and a clutch wheel co-operating to form part of a mechanism for setting the time indication, said stator being so arranged that the clutch wheel is positioned between it and the yoke.

The timepiece may include a drive means for generating a pulsiform driving signal, and means to apply the driving signal to the stator to magnetise the same to cause the rotor to rotate.

The timepiece may further include a seconds hand, a setting lever operable by the mechanism being arranged to stop the seconds hand at a position at which it indicates substantially an even number of seconds, or zero seconds. Thus the timepiece may include a stem, the position of the setting lever being determined by the stem, the arrangement being such that movement of the stem from an inoperative position to a time setting position causes the setting lever to prevent the driving means generating the drive signal and rotation of the stem in said time setting position sets the time indication.

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

Figure 1 shows the waveform of a pulsiform driving signal for driving an electric timepiece according to the present invention;

Figure 2 is a plan view of an electric timepiece according to the present invention; and

Figure 3 is a cross-sectional view of the timepiece of Figure 2.

Referring to the drawings, and in particular to Figures 2 and 3, there is shown an electric timepiece, for example, a watch according to the present invention. The timepiece comprises a stator having three parallel laminations 1, 2, 20. The stator is screwed to a base plate 30 of the timepiece. A coil 17 is wound about a neck 2' of the stator. A pulsiform driving signal, having a waveform as shown in Figure 1, and generated by a driving circuit 90 is applied to the coil 17. The driving signal causes a magnetic field to be generated in the stator. The driving signal comprises alternately occurring pulses of opposite polarity, the time between each pulse being 1 second. Thus the magnetic field generated in the stator reverses its direction every second.

A rotor 3 has its circumference radially divided into six segments and is magnetised so that alternate segments are S poles and the other segments are N poles. Thus it will be appreciated that the stator and the rotor 3 form a driving motor for the timepiece.

A positioning cam 4 is fixed to a rotor pinion 14 on which the rotor 3 is mounted in such a way that when the cam is positioned at 4a, the rotor is arranged as shown in Figure 2. The cam 4 is substantially triangular in shape and is rigidly connected to the rotor.

A setting lever 5 is pivotally mounted for movement about a pin 11 fixed to the base plate. The setting lever 5 has a pin 15 projecting therefrom, the pin 15 engaging with an end of a stem 7. A setting lever spring 6 is mounted to engage a part 5' of the setting lever 5 so that the latter is urged in a clockwise direction. A clutch 90

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wheel 10 is mounted to engage with a square shaped portion of the stem 7. When the stem 7 is pulled out to a time setting position, the position of the clutch wheel 10 relative to the stem is such that a crown gear 10c occupies the position shown at 10b and in this position the clutch wheel can be rotated by the stem and can rotate a setting wheel (not shown) *via* the crown gear. When the stem is pushed in to an inoperative position, the position of the clutch wheel relative to the stem is 10a and in this position the clutch wheel and the setting wheel are out of engagement so that rotation of the stem does not cause rotation of the hands of the timepiece.

A fourth wheel 12 which meshes with teeth on the rotor pinion 14 makes one complete revolution each minute. A seconds hand (not shown) is attached to the fourth wheel so that the seconds hand is either directed to an even numbered second (or zero) when the cam 4 is located at 4a or directed to an odd numbered second when the cam is located at 4b. A third wheel 13 meshes with the fourth wheel to rotate a minutes hand (not shown) *via* a centre wheel (also not shown).

One terminal of a re-set circuit 100 is electrically connected with the setting lever 5 *via* the base plate. The other terminal of the re-set circuit is in electrical connection with a pin 9 which is mounted on the base plate but which is electrically insulated therefrom by a bush 8. The re-set circuit 100 is OFF during normal operation of the timepiece since the electrical circuit between its terminals is incomplete because the part 5' of the setting lever 5 is out of contact with the pin 9. When the re-set circuit is turned ON by the part 5' of the setting lever 5 coming into electrical contact with the pin 9 when the stem 7 is pulled out, the re-set circuit prevents the driving circuit 90 from generating the driving signal and so no driving signal is applied to the coil 17. At the moment when the re-set circuit 100 is turned OFF again a first pulse of the driving signal is applied substantially immediately to the coil 17.

When setting the time indication of the timepiece, the stem 7 is pulled out to the time setting position and the clutch wheel moves from the position 10a axially inwards by co-operation of a setting member (not shown) and a yoke 16. The crown gear 10c of the clutch wheel is engaged with the setting wheel and thus with a gear train (not shown) so that rotation of the stem permits the hands of the watch to be rotated. As the stem is pulled out to the time setting position the pin 15 on the setting lever is disengaged from the stem. Thus the setting lever rotates under the action of the setting lever spring 6 and so assumes a position 5b

where the part 5' of the setting lever is in electrical contact with the pin 9 causing the re-set circuit 100 to return to ON. If the magnetic poles of the rotor are positioned relative to the stator as shown in Figure 2, that is to say, the cam 4 is positioned at 4a, the setting lever 5 moves to the position 5b without rotating the cam and the re-set circuit is operated as mentioned previously. Accordingly, if the stem 7 is pulled out to the time setting position when the seconds hand is directed to an even numbered second (or zero) the rotor being in the position as shown in Figure 2 and the cam being at 4a, the seconds hand stops in a position in which it is directed to that even numbered second (or zero). If the stem is then rotated the hands of the timepiece may be adjusted. As is conventional whilst the hands are being adjusted the centre wheel slips relative to a cannon pinion (not shown) on the minutes hand. Even so, some torque is still transmitted to the rotor pinion 14 through the third and fourth wheels but as the setting lever 5 is engaged with the cam 4, the rotor 3, the centre wheel and the third and fourth wheels do not rotate. After adjusting the minutes and hour hands, if the stem 7 is pushed in to the inoperative position at a given instant which may, for example, be determined from a radio time signal based on a standard time, the stem engages the pin 15 causing the setting lever 5 to rotate in the counterclockwise direction so that the part 5' of the setting lever is out of electrical contact with the pin 9 and the re-set circuit 100 is turned OFF. Thus the driving circuit 90 produces a first pulse substantially immediately and this first pulse is applied to the coil 17. This first pulse causes the stator to be magnetised as shown in Figure 2. However, the rotor 3 remains attracted to the stator and so does not rotate. After 1 second, a second pulse from the driving circuit is applied to the coil 17 and this second pulse is of opposite polarity to the first pulse so the stator is magnetised in the opposite direction to that shown in Figure 2 causing the rotor 3 to rotate in a clockwise direction. Thus after a time lapse of 1 second since the stem has been pushed in to the inoperative position, the seconds hand has moved a distance equivalent to 1 second and the timepiece agrees with the standard time.

If the cam 4 is at 4b when the stem is pulled out to the time setting position, that is to say if the poles of the rotor 3 are arranged oppositely to those shown in Figure 2, the cam 4 is rotated when the setting lever moves from the position 5a to the position 5b so that the cam is at 4a. Therefore, the timepiece will still agree with the standard time when the stem is pushed in to the inoperative position.

It will be appreciated that the setting lever ensures that when the stem is pulled out to the time setting position the seconds hand is always indicating an even numbered 5 second (or zero) and when the stem is pushed in to the inoperative position the seconds hand rotates after a time lapse of 1 second.

10 The setting lever 5 is mounted above a recess in the base plate and is spaced from the stator by a predetermined distance as the setting lever is restricted between the base plate and the stator, the stator serves also for surely positioning the setting 15 lever.

When the timepiece shown in Figure 2 is a watch and is inserted into a watch case (not shown) the stem must be removed before the timepiece can be inserted and then 20 the stem is replaced when the timepiece is safely in the case. Heretofore, in order to prevent misalignment of the clutch wheel when the stem was removed, the clutch wheel was held from the side of the base 25 plate by the yoke and from the side of the gear train was held by a bridge or other special part designed for the purpose.

In the present embodiment, the stator comprises three thin laminations 1, 2, 20 30 arranged so that the thin laminations 1, 2 overlap the clutch wheel and are spaced therefrom and the thin lamination 20 does not overlap the clutch wheel. Thus not only is the magnetic resistance of the stator 35 reduced and the magnetic efficiency improved, but also, when the stem is removed the clutch wheel is supported by the yoke and by the stator so that the stem can be easily re-inserted. The distance between 40 the clutch wheel and the stator is just great enough to allow the clutch wheel to rotate freely.

It will be appreciated that whilst the stator requires a considerable proportion of 45 available space so that the necessary magnetic field can be generated, it also serves to determine the position of the setting lever and the clutch wheel.

The above described timepiece is such 50 that it may be used in a small space of a

watch. Thus it permits the watch to be miniaturised and also simplifies the watch construction. Furthermore, the number of parts of the watch is reduced.

Attention is drawn to the claims of our 55 co-pending Application No. 6522/72 (Serial No. 1377429).

Having regard to the provisions of Section 9 of the Patents Act 1949 we draw 60 attention to our Patent No. 1,302,220.

#### WHAT WE CLAIM IS:—

1. An electric timepiece including a driving motor having a stator and a rotor, and a stem yoke and a clutch wheel co-operating 65 to form part of a mechanism for setting the time indication, said stator being so arranged that the clutch wheel is positioned between it and the yoke.

2. An electric timepiece as claimed in claim 1 including a drive means for generating a pulsiform driving signal, and means 70 to apply the driving signal to the stator to magnetise the same to cause the rotor to rotate.

3. An electric timepiece as claimed in claim 2 including a seconds hand, a setting 75 lever operable by the mechanism being arranged to stop the seconds hand at a position at which it indicates substantially an even number of seconds, or zero seconds. 80

4. An electric timepiece as claimed in claim 3 including a stem, the position of the setting lever being determined by the stem, the arrangement being such that movement 85 of the stem from an inoperative position to a time setting position causes the setting lever to prevent the driving means generating the drive signal and rotation of the stem in said time setting position sets the time 90 indication.

5. An electric timepiece as claimed in claim 1 and substantially as herein described with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

J. MILLER & COMPANY,  
Agents for the Applicants,  
Chartered Patent Agents,  
262 High Holborn,  
London WC1V 7EF.

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