

DRAWINGS ATTACHED

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(54) ELECTRONIC TIMEPIECE

(71) We, EBAUCHES S.A., a Swiss Body Corporate, of 1, Faubourg de l'Hôpital, Neuchâtel, 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 an electronic timepiece.

In accordance with the invention, an electronic timepiece comprises a driving mechanism which also acts as a regulator, the oscillations of said mechanism being maintained electronically by means of a transistorised circuit comprising at least a pick-up winding and a driving winding, and two plates on which said windings are respectively secured, one of said plates also carrying one or more transistors and at least one of the other elements of the transistorised circuit, wherein said mechanism comprises a counting wheel pivoted between a base plate and a gear train mounting plate, said base plate carrying a sleeve which is coaxial with the axis of the counting wheel and projects towards the mounting plate, in which sleeve the counting wheel is freely supported with the sleeve preventing the wheel from rocking during fitting of said mounting plate.

One embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a plan view, from above, of the clockwork of an electric watch with an oscillatory resonator,

Figure 2 is a plan view of the resonator of the watch shown in Figure 1,

Figure 3 is an elevational view of the resonator shown in Figure 2,

Figure 4 is a diagram of an oscillation sustaining electric circuit,

Figure 5 is an elevational view of part of

a friction coupling, and

Figure 6 is a sectional view along the line VI-VI of Figure 1, on a larger scale.

The watch shown comprises a driving mechanism which also acts as a regulator, the mechanism consisting of a symmetrical flexure resonator of which the two flexible blades 1 (Figures 1, 2 and 3) are connected at their base by a median portion 1a rigid with a tongue 1b attached to a base plate 2 of the clockwork. Each flexible blade 1 carries at its free end a magnetic bar 3, associated with a transducer, which serve to maintain the oscillations of the resonator. The position of the resonator is offset in relation to the centre of the movement, as shown in Figure 1.

Each flexible blade 1 further carries, at its free end, in the neighbourhood of the transducer, a rigid arm 4, directed towards the median portion 1a, and terminating in an enlarged part 4a. Each enlarged part 4a has secured thereto a trunnion 5 on which is forced a washer 6 forming a counterweight. On each washer 6 is located a star-shaped inertia member 7 with three branches, one of which is bored with a hole 8 producing an asymmetry such that the centre of gravity of the member 7 does not coincide with its geometrical axis. Thus, by turning the star-shaped members 7, the moment of inertia of the resonator is modified, which enables modification of its frequency and adjustment of the running of the watch.

Due to the presence of these rigid arms 4, the instantaneous rotational centre of each of the two symmetrical parts of the resonator coincides with its centre of gravity, as has been shown in Swiss Patent No. 451029, so that the frequency of the oscillations of the resonator does not alter with variations of its position in a field of force, particularly in the field of gravity.

The maintenance of the oscillations of the

resonator is ensured by means of a transistorised circuit, the diagram of which is shown in Figure 4. This circuit comprises a current source 10 supplying, when the transistor is conducting, a driving winding comprising two windings 12 and 13, intended to cooperate with the magnets 3 of the resonator, and a pick-up winding 14, in which current is induced by one of the magnets 3, and which switches on the transistor 11 so that the driving pulses are applied to the windings 12 and 13.

It is to be noted that, in practice, the pick-up winding 14 is combined with one of the driving windings, for example winding 12, in a single winding.

The two windings 12-14 and 13 are respectively mounted on two plates of insulating material 15 and 16 which are secured to the base plate 2. Plate 15 is secured by means of three screws 17, 18 and 19 and plate 16 is secured by means of two screws 20 and 21. The windings are stuck by their bases on the edges of the plates in two zones, 22 and 23, respectively, facing each other in such a manner that the windings are coaxial and in alignment, which allows the magnets 3 to be received therein.

The current source 10 is constituted by a battery held in place by a small bar 24, which also ensures an electrical contact. The transistor 11 and other elements of the transistorised circuit, such as a resistance 25 and a condenser 26, are mounted on the plate 15.

It is to be noted that the screws not only secure the plates 15 and 16 to the base plate 2, but they also provide electrical connections. Thus, a lead 27 connects one of the poles of the combined winding 12-14 to the screw 17, a lead 28 connects the emitter 29 of the transistor 11 to the screw 18, and leads 30 and 31 connect the two poles of the winding 13 to the screws 20 and 21.

The oscillator comprises both the driving and regulator mechanism of the watch. To this end, it actuates a counting device, comprising a pawl 32 pivoted at 33 on the enlarged part 4a of one of the rigid arms 4 of the resonator, this pawl acting on a counting ratchet wheel 34.

The counting device is practically insensitive to accelerations, particularly those due to shocks, to which the timepiece is subjected, as described and explained in detail in our Patent No. 1,121,424.

The counting ratchet wheel 34 is prevented from reverse rotation by a retaining pawl 35 fixed at 36 on a plate 37 through which a clamp screw 38 passes with play and is screwed in the base plate 2. An eccentric 39 allows the plate 37 to be turned slightly about a trunnion 66 carried by the base plate, which allows the fine adjustment

of the position of the retaining pawl 35 with respect to the position of the driving pawl 32 to be made. This adjustment of the relative position of the two pawls is necessary so that the counting is correctly carried out. In fact, this relative position must be determined with a great degree of accuracy which is difficult to obtain by a manufacturing process, so that it is necessary that this relative position can be adjusted.

The counting wheel 34, driven step by step by the pawl 32, is rigid with a pinion 40 meshing with the wheel 41 of an intermediary gear the pinion 42 of which meshes with the seconds-wheel 43, located in the centre of the timepiece.

The pinion 40 of the counting gear 34, 40 freely traverses a tubular sleeve 44 which is secured to the base plate 2 of the clockwork and which is provided with a notch allowing passage of the wheel 41. This tubular sleeve 44 prevents any risk of damaging the counting gear 34, 40 during the fitting of the clockwork. In fact, when the counting gear is placed in its lower bearing 46, it is supported by the sleeve 44, which permits an easy fitting of a gear-train mounting plate 47.

The driving of the minutes indicator is indirect. The seconds-wheel 43, located in the centre of the timepiece, is provided with a pinion 48 meshing with a wheel 49, the pinion 50 of which meshes with the wheel 51 of the minutes gear. The pinion 52 of this minutes gear meshes with the wheel 53 of the dial-train, the pinion 54 of which meshes with the hour-wheel 55.

the shaft 48a of the pin in 48 carries a bush 56 which carries a grooved wheel 57 against which a spring 58 bears, acting as a brake, preventing movement of the seconds hand due to backlash.

The connection between the wheel 49 and its pinion 50 is ensured by a friction coupling comprising a collet 59 which is radially slotted at 60 and which is forced on a bush 50a of the pinion 50. The upper axial face of the collet is provided with a notch in which is engaged one of the edges 61a of a blade-spring 61 (Figure 5), the opposite edge 61b of which bears on the cylindrical axis 62 of the gear 49 (Figure 6).

The watch shown comprises a date indicating crown 63, having an inner tothing 64, rotatably mounted on the base plate 2, and which is driven step by step, at the rate of one step each 24 hours, by a mechanism which is not shown.

A hands-setting stem 65 is slidably mounted on the base plate 2 and is able to occupy three positions, namely a locking or neutral position, in which it is entirely pushed in, and in which it is inoperative, a setting position, in which it is entirely pulled out and in which the setting of the

hands of the watch may be effected, and a third intermediary position in which rotation of the date crown is permitted for the setting of the calendar.

5 The oscillatory resonator shown in and described with reference to Figure 2 is also disclosed in our co-pending Application No. 43248/69 (Serial No. 1 262 175), the claims of which are directed to features embodied  
10 in that resonator.

WHAT WE CLAIM IS:—

1. An electronic timepiece comprising a driving mechanism which also acts as a  
15 regulator, the oscillations of said mechanism being maintained electronically by means of a transistorised circuit comprising at least a pick-up winding and a driving winding, and two plates on which said windings are  
20 respectively secured, one of said plates also carrying one or more transistors and at least one of the other elements of the transistorised circuit, wherein said mechanism  
25 comprises a counting wheel pivoted between a base plate and a gear train mounting plate, said base plate carrying a sleeve which is coaxial with the axis of the counting wheel and projects towards the mounting plate, in  
30 which sleeve the counting wheel is freely supported with the sleeve preventing the wheel from rocking during fitting of said mounting plate.

2. A timepiece according to claim 1, wherein each of the said plates is secured  
35 to the frame of the clockwork by means of screws at least some of which additionally ensure electrical connections for said circuit.

3. A timepiece according to claim 1, wherein said windings are respectively  
40 secured by their bases to the edges of the

plates, said edges facing each other, in such a way that the two windings are coaxial and in alignment.

4. A timepiece according to claim 1, wherein said counting wheel is driven by a  
45 pawl actuated by the regulator, and the counting wheel is prevented from reverse rotation by a retaining pawl, wherein the retaining pawl is mounted on the frame of the clockwork in an adjustable manner,  
50 whereby its relative position with respect to the driving pawl can be adjusted.

5. A timepiece according to claim 1, the gear train of which comprises a gear formed of two elements idle with respect to one  
55 another and connected by a frictional coupling, wherein said coupling carries a resilient plate embedded by one of its edges in a groove provided in the radially extending  
60 face of one of the elements, and bearing with its opposite edge on a cylindrical axis of the other element.

6. An electronic timepiece substantially as herein described with reference to the  
65 accompanying drawings.

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Reference has been directed in pursuance of Section 9, Subsection (1) of the Patents Act, 1949, to Patents Nos.:—1,099,665; 955,559 and 854,196.

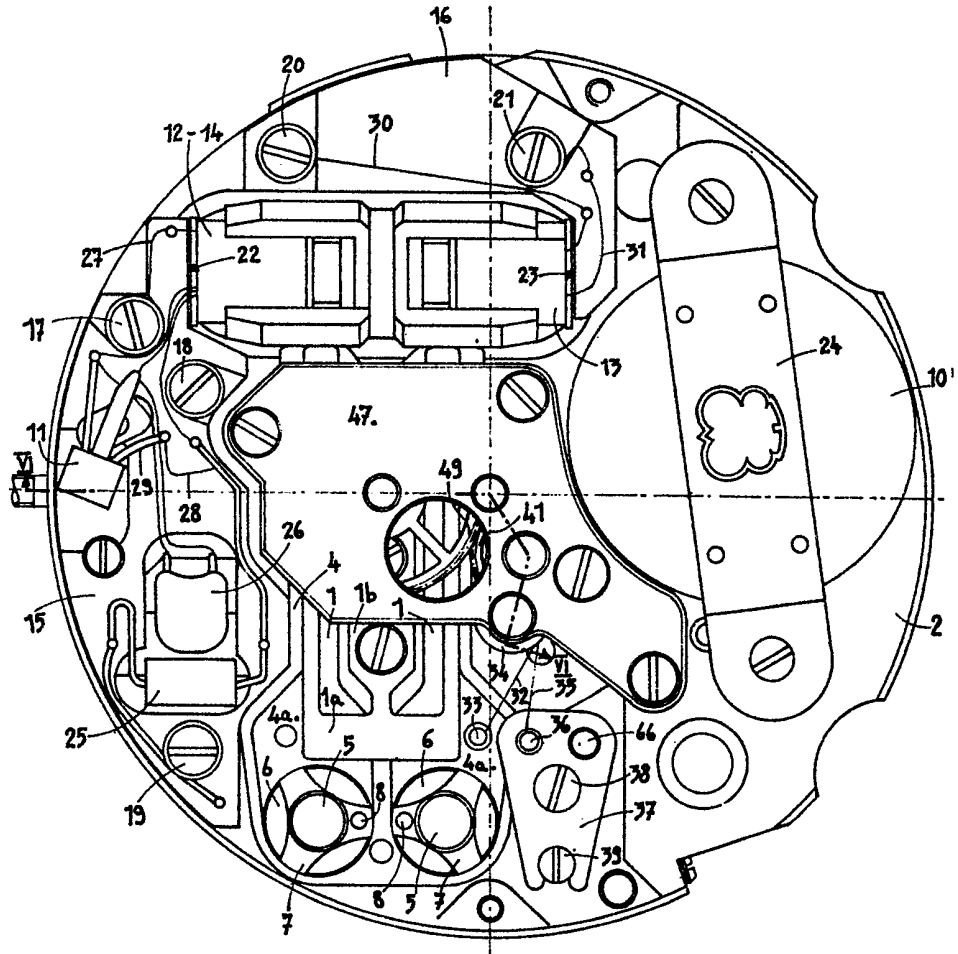
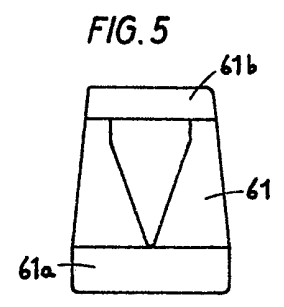
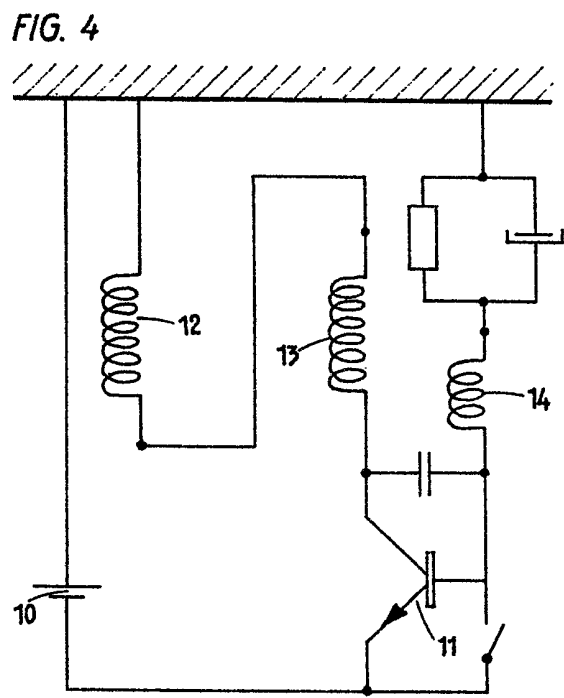
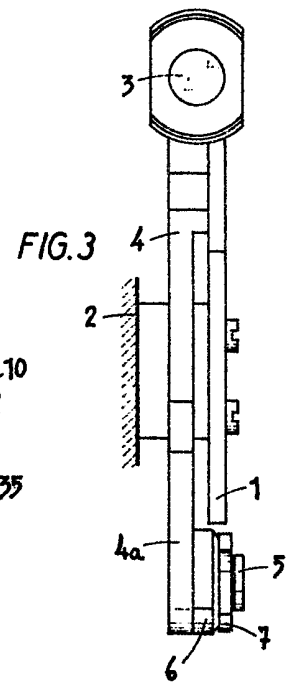
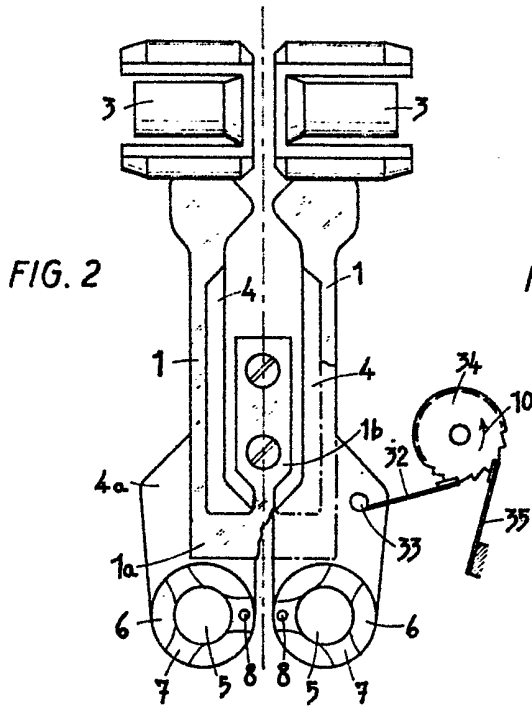


FIG. 1



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

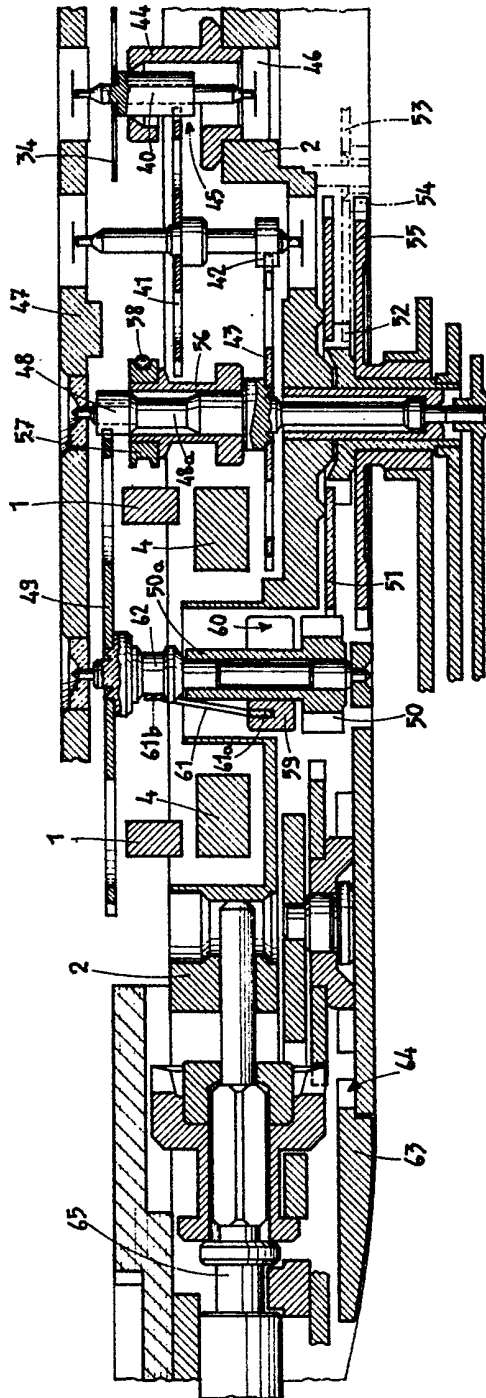


FIG. 6