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ELECTROMECHANICAL CHRONOMETER DRIVING MECHANISM.
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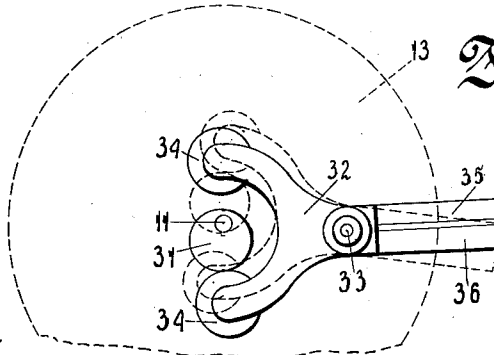


Fig. 4.

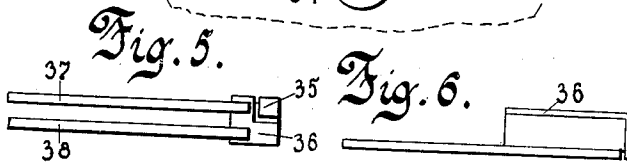
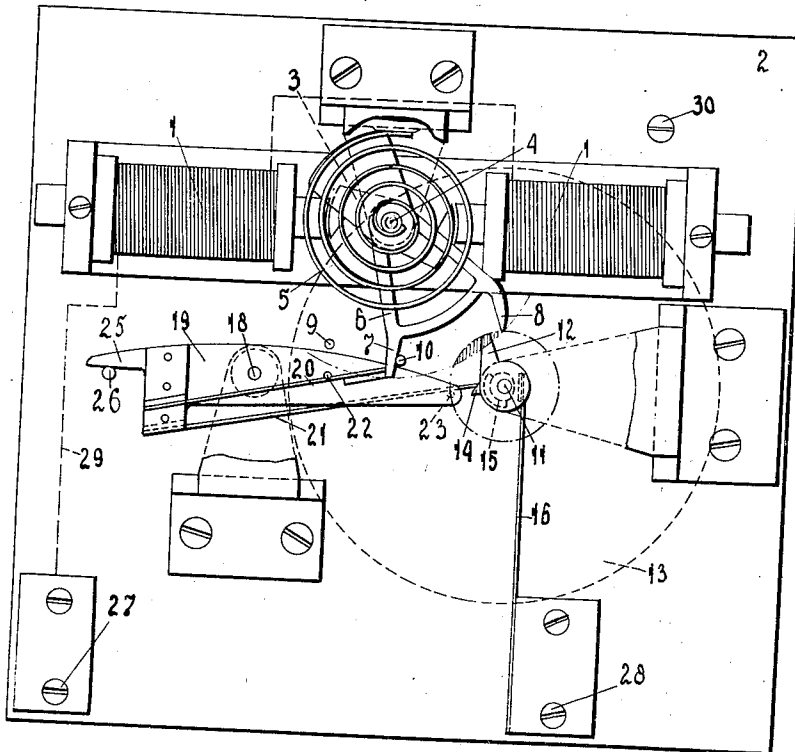


Fig. 5.

Fig. 6.

Fig. 1.



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ELECTROMECHANICAL CHRONOMETER DRIVING MECHANISM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CORNELIS DENIS JOSEPH JAMIN, a subject of the Queen of the Netherlands, residing at Rotterdam, Netherlands, have invented certain new and useful Improvements in Electromechanical Chronometer Driving Mechanisms, of which the following is a specification.

The present invention relates to chronometer driving mechanisms, and in particular to mechanisms of the type shown and described in German Patent No. 71631, in which a rotatably mounted armature, electromagnetically controlled, is employed to operate a balance device through the intermediary of a rocker. According to the patented construction, the driving force exerted by the armature upon the rocker is directly proportional to the current in the magnet coils. Consequently, with the decrease of the current there is an accordant decrease in the amplitude of movement of the balance. In this invention, on the other hand, the rocker is operated both by electromagnetic force and by a practically-constant mechanical force, the latter force being produced by the former, the inertia set up in the rocker by the mechanical force being transmitted to the balance, which regulates the times of action of the two forces.

Usually, the driving mechanism of a chronometer comprises a driving wheel having about fifteen teeth, each of which serves both as a driver and as a stop. According to my invention, the member which is operated alternately by the electromagnetic and mechanical forces consists of a soft iron armature, to which a rocker in the form of a driving sector is connected, this sector having only two teeth, one of which acts only as a stop while the other works always as a driver. The armature is rotatably mounted between two magnets which when energized, serve to rock it in one direction, the return movement taking place under the influence of a spring or equivalent device upon the opening of the magnet circuit.

An embodiment of the invention is illustrated in the accompanying drawing, in which:

Figure 1 is a plan view of the improved mechanism;

Fig. 2 is a front elevation of Fig. 1;

Fig. 3 is a front elevation of the beam, which is omitted from Fig. 2; and

Figs. 4 to 6 are detail views showing a

modified device for closing the magnet circuit.

Referring more particularly to the drawing, 1 designates a pair of electromagnets mounted on a metal base plate 2 and having endwise-adjustable cores which are disposed in axial alinement and are spaced apart at their confronting ends. In the space between said core ends there is arranged a soft iron armature 3, which is fixed to a vertical shaft 4, the latter having its pointed ends fitted in suitable bearings (Fig. 2) and having connected to it a spiral spring 5 that tends to turn it in a clockwise direction. A driving sector 6 is also secured to said shaft, and is provided with two spaced teeth 7 and 8, the last mentioned tooth constituting a driving means, as hereinafter explained, while the first-mentioned tooth projects between two spaced pins 9 and 10 and, hence, serves as a stop to limit the swinging movements of the sector in opposite directions.

In advance of the armature shaft 4, and to one side thereof, is mounted a second vertical shaft 11, carrying the horizontally arranged balance wheel 13 and, in addition to the same, a pair of teeth 12 and 14 offset one above the other and, below them, a platinum contact-piece 15. The latter contacts with a spring contact 16 which is connected to a terminal 28 fixed to the base plate; and the tooth 12 projects at its extremity into the path of the driving tooth 8. The balance shaft 11 has connected to it one end of a spiral spring 17 (Fig. 2).

A third vertical shaft 18 is mounted in the base plate at about the same distance in front of the armature shaft 4 as the balance shaft, but to the left of said armature shaft instead of to the right thereof. To this shaft 18 there is fastened a beam 19, which is provided at its upper and lower sides, respectively, with leaf springs 20 and 21 (Figs. 1 and 3), said springs being attached to one end of the beam, and arranged to act horizontally. The upper spring 20 is thickened at its free end, as shown, and coacts with the stop tooth 7 on the sector 6, its movement or action in a counter-clockwise direction being limited by an up-standing pin 22 on the beam. The movement or action of the lower spring 21 is similarly limited, but in a clockwise direction, by a depending pin 23 on the beam. Shaft 18 has a normal tendency toward counter-clockwise

movement due to its connection to one end of a spiral spring 24 (Fig. 3), such movement holding a terminal projection or lug 25 on the beam against a fixed pin 26 on the

base plate. In addition to the afore-mentioned terminal 28, to which the contact spring 16 is connected, there is a second terminal 27 which is likewise secured to the base plate, both terminals being spaced by insulation from the base plate, and the spring 16 also being spaced therefrom. These terminals are connected to a source of continuous current, and the terminal 27 is connected, in turn, by wiring 29 first to the left-hand magnet coil, then to the right-hand magnet coil and then to a screw 30 carried by the metal base plate 2. From this screw the current passes through the base plate or ground to the balance shaft 11 and contact 15, and finally, when said contact is engaged with the spring 16, from the latter to the other terminal 28.

Operation takes place substantially as follows: The balance wheel 13 is first turned by hand counter-clockwise or to the left, the initial position of the parts being such that the tooth 14 on the balance shaft 11 is disposed slightly behind the free end of the lower spring 21. This movement of the balance wheel brings said tooth against said spring end and, as the movement continues, forces the spring forward, the pressure of the spring being exerted directly against the pin 23 on the beam 19 with the result that the latter is rocked in a clockwise direction. Fig. 1 shows the position of the parts just at the moment when the engagement of the tooth and spring takes place. The upper spring 20 moves with the beam, and its free end is thus disengaged from the stop tooth 7 on the driving segment 6, which is thereby enabled to swing or turn clockwise under the influence of spring 5 until it is stopped by its finger 7 striking against pin 9. The beam or rocker is returned to its normal position by spring 24 immediately after the release of spring 20 from tooth 7 has taken place, the lug 25 on the beam reengaging pin 26.

During the above-described rocking or swinging movement of the sector, its driving tooth 8 engages the tooth 12 on the balance shaft 11, which latter is turned thereby, so that in this way the energy accumulated in spring 5 is transmitted to the balance which thus receives at each stroke of the sector a certain amount of energy equal to the loss by friction and other resistances; and this transmitted energy is stored in the spiral spring 17 which is thereafter utilized to effect the return movement of the balance.

The different parts of the mechanism are so arranged that just at the time when tooth 8 disengages tooth 12, the stop tooth 7 on the sector strikes against pin 9. At

the same moment, the contact 15 on the balance shaft engages the contact spring 16. This closes the magnet circuit, the resultant energizing of the magnets producing a counter-clockwise rotation of the armature 3 and its shaft 4 in opposition to the action of spring 5, which effects the return movement of the sector and the reengagement of tooth 7 with pin 10 and spring 20, due to which the sector is temporarily locked against operation. The respective angular positions of teeth 12 and 14 and contact 15 must be such that engagement between the contacts 15 and 16 takes place simultaneously with the stoppage of tooth 7 by pin 9; and that at the end of the leftward movement of the balance, contact 15 has passed beyond contact 16, but afterward, during the return or rightward movement of the balance caused by the action of spring 17, said contacts are reengaged, although no second impulse of the magnets is necessary because the sector 6 is held in its proper position by spring 20.

This second closing of the circuit, although exerting no influence upon the actual working of the mechanism, may well be avoided, for instance in order to reduce current consumption. For that purpose, the arrangement illustrated in Figs. 4 to 6 may be adopted. The balance shaft 11 is here provided with an eccentric disk 31 which is positioned between the arms of a forked lever 32, pivoted at 33 and normally held in an intermediate or neutral position by a spring or other suitable means (not shown), the lever arms being preferably furnished with rollers 34 against which the eccentric acts, to reduce friction. The opposite portion or stem of the lever carries two insulated contact strips 35 and 36, both of which are bent down around the free end of the stem, as shown in Fig. 6, the bent part of strip 36 being constructed and extended to reach under the bent part of strip 35 (see Fig. 5). Two spaced contact springs 37 and 38 are arranged tangential to the path through which the free end of the stem portion of the lever travels, contact between said springs being bridged by the bent end of the strip 36 during the movement of the lever in one direction from its neutral position. On the other hand, when the lever moves in the opposite direction from its neutral position, spring 37 will be engaged by strip 35 and strip 36 will only engage spring 38, and in this instance there will be no bridging of the springs and, hence, no closing of the circuit. With this arrangement, however, the circuit is slightly different from the one above described, for instead of the current passing from the second or right-hand magnet to the base plate or ground it passes to the spring 37, for instance, which is indirectly in permanent

connection with the leading in terminal, while spring 38 is connected with the other terminal.

The spring 17 which, by its release, causes the balance shaft and its wheel to turn to the right (contact being made once or twice between the parts, as described above), will continue this movement until tooth 14 has disengaged spring 21, at which point said spring 17 is tensionless. The balance wheel, however, will turn beyond this position by reason of its inertia; and spring 17, after exhausting the inertia of the said wheel, will return as far to the left as is necessary for the unlocking. The cycle of operations is repeated until the current is exhausted or is too weak to energize the magnets.

The operation of the dial train may be effected mechanically from the balance shaft in any suitable manner, for example by utilizing a pawl-and-ratchet device operable either mechanically by an eccentric on said shaft or electrically by interposing a secondary clock in the magnet circuit. In the latter instance, the clock receives a current impulse at each oscillation of the balance wheel, this arrangement having the advantage that it does not increase friction and other resistances to the chronometer driving mechanism.

While the embodiment illustrated includes the spiral spring 5 which is tensioned automatically consequent upon the energizing of the magnets, it will be understood that said spring can be replaced by a weight or other source of energy.

What I claim is:

1. Chronometer driving mechanism, comprising a member movable alternately by electromagnetic force and by a constant

mechanical force produced by the electromagnetic force; and a balance for regulating the times of action of the two forces, said member transmitting to said balance the inertia set up in it by the mechanical force.

2. Chronometer driving mechanism, comprising an armature, electromagnets for influencing and between which said armature is pivotally mounted, a driving sector carried by the armature and having two teeth, one tooth for driving the chronometer and the other tooth for stopping the sector as desired, and means for exerting a constant mechanical force upon said sector and armature in a direction opposed to that exerted thereon by said electromagnets.

3. Chronometer driving mechanism, comprising a balance shaft, a movable member, an electromagnet for controlling movements, in one direction, of said member, means for including said electromagnet in circuit as desired and including a movable arm having a forked end, and an eccentric disk carried by the aforesaid balance shaft and fitting the said forked end of the arm.

4. Chronometer driving mechanism, comprising a balance shaft, a movable member, an electromagnet for controlling movements, in one direction, of said member, means for including said electromagnet in circuit as desired, and including a movable arm controlled by the balance shaft and having insulated contact at one end thereof, and contact springs in the path of the contacts aforesaid.

In testimony whereof I have hereunto set my hand.

CORNELIS DENIS JOSEPH JAMIN.