

## DESCRIPTION

The present invention relates to electronic timepieces with analog display. More particularly, the invention concerns an analog watch in which the shafts for the hands as well as the rotor of the stepping motor are rotatably mounted in the stator of the stepping motor, while the pivoted parts of the movement which are not supported by the shafts of the hands are also rotatably mounted in the stator. Thus though the stator is realised in a soft magnetic material, it serves, with no need for any bridge, as the only plate for the assembly of the elements which comprise the motor module.

A watch of this type is made and sold under the brand name SWATCH by the patentee. Its construction is also described in patent application GB-2 094 039.

This technique permits not only the elimination of a bridge, but also the provision of a watch of a relatively slight thickness which is easy and inexpensive to manufacture. Moreover, the mounting of the motor module in the watch requires no delicate operations.

The present invention concerns a further improvement in the direction open by the proposal made in the above-identified patent application. The improvement concerns the mounting of the time control or setting mechanism of the watch, which generally comprises a sliding setting stem; a contrate toothed pinion, known as a sliding pinion, mounted to slide along but rotate with the stem; a mechanism comprising a rocker and a pulling crank, which respond to sliding of the stem to move the sliding pinion between a rest position and an active position; and finally, a setting pinion meshing with one of the gear wheels of the motor module and with the sliding pinion, when the latter is in the active position.

Thus, the object of the invention is an electronic time-piece having a support element, a motor including a coil, a stator made of a soft magnetic material, which are fixed on the support, and a rotor pivotably mounted in the stator,

shafts for hands are also pivotably mounted in the stator, gear means providing a kinematic connection between the rotor and the shafts for hands, said gear means being either mounted on said shafts or pivotably mounted in the stator, and a sliding setting device comprising a setting stem, a contrate toothing pinion slidably mounted on said setting stem and rotatably secured to it, a mechanism for responding to the sliding of the stem for moving said pinion between a rest position and an active position, and a setting pinion meshing with one of said other gear means and with said pinion when the latter is in the active position.

According to the invention, this improvement is realised in such an electronic timepiece by the means which are recited in the characterizing part of claim 1.

Thus, a module is provided which includes, obviously with the exception of the setting stem, all of the moving elements of the watch (motor, gear means, shafts for the hands and setting device) whose assembly require rather delicate operations. This module can therefore be provided separately by regrouping all the delicate operations in one phase of manufacture and then mounted in the watch by an operation which requires no particular precision. Moreover, and this constitutes an important advantage of the invention, the position of the setting pinion with respect to the rocker and pulling crank assembly is perfectly guaranteed.

So, the defined electronic timepiece is different from most of known pieces, such as the ones described in FR-A-22899470, US-A-4 243 329, GB-A-2 023 890 and GB-A-2 094 518, in which the plate serves as a support element for the gear train as well for the setting mechanism.

Other characteristics and advantages will appear from the description which follows, made with reference to the attached drawings and giving, by way of explanation but in no way of limitation, one advantageous embodiment of the invention. In the drawings :

- Figure 1 is a plan view of an electronic timepiece according to the invention;

- Figure 2 is a partial view in vertical section along the line II-II in Figure 1; and

- Figure 3 is another view in vertical section along the line III-III in Figure 1.

In these figures there is shown the very particular shape of the stator 10 of a Lavet motor, which simultaneously has the normal function of a magnetic circuit for guiding the magnetic field created by the coil and the additional function of providing a single plate for the gear wheels, the shafts for the hands and the setting mechanism. This stator is made, for example, of a ferro-nickel alloy sold under the brand name VACOPERM and typically has a thickness of 0.7 mm.

Figure 1 shows that stator 10 has approximately a V-shape, of which the ends are joined to the core 12 of a coil 14. Stator 10 is pierced by a circular bore 16, in which is mounted the rotor 18 of the stepping motor. On opposite sides of the bore, two notches 20 and 20' are made in the stator to define two narrow isthmuses separating the two poles of the stator. Two other notches, 22 and 22', positioned diametrically opposite each other on bore 16 are displaced by about 50 degrees in relation to the diameter which joins notches 20 and 20', thereby defining, as is conventional in such a motor, the rest position of rotor 18.

As seen in Figure 2, a cup-shaped member 24, closed by a plate 26, is force fitted into bore 16. Rotor 18, which is rotatably mounted inside cup-shaped member, comprises a magnet 28, mounted inside a cage 30, which is fixed on a shaft 32 journaled in a bearing provided in the bottom of member 24, and on a shaft journaled in a bearing provided in plate 26. Shaft 34 extends away from member 24 by a pair lugs 36, 36' which function as a pinion.

Thus, one can see that pieces 24 and 26 assure proper positioning of the rotor in relation to the stator. There is avoided, in this way, the delicate operation of centering the

rotor in the stator during the mounting of the movement assembly.

Moreover, stator 10 is pierced, substantially at its center, by a second bore 38, which serves for the mounting of the shafts of the hands. Into this bore is driven a guide tube 40 which projects beyond the upper surface of the stator. The shaft 42 for a second hand, at the end of which the second hand (not shown) will be mounted, is journaled within guide tube 40. The lower end of shaft 42 bears a seconds gear 44, comprising a seconds wheel 44a meshing with lugs 35, 36' and a seconds pinion 44b. On the outer surface of guide tube 40 is mounted a minutes gear 46, comprising in the conventional way a cannon-pinion formed by a pipe 46a at the end of which a minutes hand (not shown) is mounted, a minutes pinion 46b and a minutes wheel 46c. On the outer surface of pipe 46a of the cannon-pinion is mounted an hour cannon gear 48 comprising on the one hand a pipe 48a for an hour hand (not shown) and on the other hand an hours wheel 48b.

Stator 10 includes a third bore 50, in which is force fitted a sleeve 52, which has an axial bore 54, serving as a bearing for a shaft 56 which extends from one side to the other of stator 10. At its lower end is fixedly mounted an intermediate gear wheel 58 which meshes with seconds pinion 44b. At its other end, shaft 56 fixedly supports a pinion 60 which meshes with minutes wheel 46c. Furthermore, the upper end of shaft 56 is trued to rotatably support an hours moving gear 62 comprising, in the conventional way, a wheel 62a meshing with minutes pinion 46b and a pinion 62b meshing with hours wheel 48b. The shaft 56 has thus a double function. On the one hand, it fixedly supports intermediate wheel 58 and pinion 60 for rotation together; and on the other hand, it rotatably supports hours moving gear 62.

The setting mechanism of the watch, shown in Figure 1, comprises a setting stem 64, slidably mounted in the middle 66, shown only partially. This stem comprises a portion 64a of square cross-section, which mates with a square bore in a

sliding pinion 68 so that stem 64 and pinion 68 rotate together. Stem 64 is in its active position when it is pulled outwardly to the position shown in Figure 1 and is inactive in the pushed-back position. The movement of the stem causes a translation movement, in the opposite direction, of sliding pinion 68 through two levers which comprise a pulling crank 70 and a rocker 72.

Pulling crank 70 is mounted rotatably on pin 74 fixed to stator 10. One end 70a of pulling crank 70 is engaged in a groove 64b on stem 64.

Rocker 72 is mounted on stator 10 to pivot around a fixed pin 76 which like pin 74 is fixed to stator 10. One end 72a of rocker 72 is engaged in a groove on sliding pinion 68, while the other end 72b is stopped against a rounded portion of pulling crank 70 which extends around pin 74. The other end 70b of pulling crank 70 may take its place in one or the other of two notches 72c and 72d formed in rocker 72. Finally, the rocker is pierced with an oblong slot 72e, through which passes a pin 78, also fixed to stator 10. This pin serves both to hold 72 in place and, in cooperation with slot 72, to limit its movement.

Sliding pinion 68 includes, on its surface facing the center of the movement, a toothed edge 68a which meshes with a setting pinion 80 which in turn meshes with wheel 62a.

As best shown in Figure 3, setting pinion 80 is rotatably mounted on a pin 82, which is force fitted into a hollow boss 84 forming an integral part of stator 10. The latter is locally stamped so as to form, on the one hand, boss 84 and, on the other hand, a groove 86 which assures accurate guiding of the end 64c of the setting stem.

A plate 88, fixed on stator 10 by means, which are not shown, partly covers the moving elements which assure a proper connection between the stepping motor and the shafts for the hands. This plate is pierced by a first opening 88a, through which the shafts for the hands pass and a second opening 88b, at the level of the upper end of the pinion 62b.

This plate assures the protection of the moving elements and at the same time, during the handling of the module, prevents the uppermost moving elements, such as hour cannon gear 48 and gear 62, from escaping from their shafts.

Finally, the seconds shaft 42 bears, at its upper part, a ring 90 which rotates freely within pipe 46a. This ring, coming to a stop against the guide tube 40, prevents seconds wheel 44 from falling during handling of the module.

The functioning of the setting mechanism follows from the above description. When stem 64 is in the pushed-back position, end 70b of pulling crank 70 takes its place in notch 72d of the rocker, and rocker end 72a pushes sliding pinion 68, and hence its toothed edge 68a, away from pinion 80. Thus sliding pinion 68 is in its rest position and rotation of the stem has no effect on pinion 80. But, when stem 64 is in its pulled position (position shown in Figure 1), end 70b of the pulling crank takes its place in notch 72c of the rocker, and rocker end 72a pushes sliding pinion 68 to its active position by moving it in the direction of pinion 80, so that the toothed edge meshes with the latter. Rotation of the stem is then transmitted through the pinion and thus permits driving the shafts for the hands to set the time.

The advantages of the invention now appear very clearly.

The first advantage is that the resultant assembly includes, except for the setting stem, all the movable mechanical elements of the watch. This assembly may be realised separately, then mounted in the watch by an extremely simple operation which requires no particular care. Another advantage of the invention resides in the complete elimination of bridges due to use of a single plate consisting of the stator of the motor itself. This results in a substantial reduction of the total thickness of a watch equipped with such an assembly. A third advantage of the invention is that since the setting mechanism and the setting pinion are mounted on the stator, it is very easy to guarantee their relative positions. Finally, a fourth advantage of the invention is

that guiding the end of the setting stem is assured without other means than the stator itself.

Obviously, the present invention is not limited to the single mode of execution shown, but the coverage of the present patent extends also to variants of all or part of the arrangements described, remaining within the frame of equivalencies, as well as any application of such arrangements.



### CLAIMS

1. An electronic timepiece having a support element (66), a motor including, on the one hand, a coil (14) and a stator (10) fixed on the support element (66) and, on the other hand, a rotor (28) pivotably mounted in the stator (10), shafts for hands (42, 46, 48) also pivotably mounted in the stator (10), gear means (36, 44, 58,...) providing a kinematic connection between the rotor and the shafts for hands, said gear means being either mounted on said shafts or pivotably mounted in the stator (10), and a sliding setting device comprising a setting stem (64), a contrate toothing pinion (68) slidably mounted on said setting stem (64) and rotatably secured to it, a mechanism (70, 72) for responding to the sliding of the stem (64) for moving said pinion (68) between a rest position and an active position, and a setting pinion (80) meshing with one of said other gear means and with said pinion (68) when the latter is in the active position, characterized in that said stator (10) is used as a bottom plate for said mechanism (70, 72) and said setting pinion (80), said setting stem (64) being slidably and rotatably mounted in the support element (66) so that, except the setting stem (64), all the movable mechanical elements of the timepiece are mounted on said stator (10).

2. An electronic timepiece according to claim 1, characterized in that said stator further comprises a groove (86) for the guiding of the end of the stem.

3. An electronic timepiece according to claims 1 or 2, characterized in that said stator (10) comprises a hollow boss (84) and a pin (82), said pin being driven in the boss (84), to realize the positioning and the pivoting of said setting pinion (80).

4. An electronic timepiece according to claims 2 and 3, characterized in that said stator (10) is locally stamped to form said groove (86) on one side and said boss (84) on the other side.



5. An electronic timepiece according to one of claims 1 to 4, characterized in that said mechanism (70, 72) comprises a pulling crank (70) and a lever (72), which are pivotably mounted on the stator (10).

6. An electronic timepiece according to claims 1 or 2, characterized in that it further comprises a middle which constitutes said support element (66).