

Biaxial tourbillon for timepieces, particularly wristwatches

In operation, the rate of a timepiece is not the same when it is in a vertical position as it is in a horizontal position. A pocket watch can, for example, be adjusted quite easily as it is placed in a vertical position most of the time. The adjustment made in this position can be carried out easily, and it will be possible to maintain a variation of 0 to 1 second per day. However, if the pocket watch is placed in a horizontal position, that is, placed on a table for example, it will be seen that the rate variation will be around 10 seconds per day.

A wristwatch is generally worn in a horizontal position. However, depending on the wearer, the average position of the watch can vary considerably. Consequently, if it is adjusted in a horizontal position, it may in some cases present a relatively significant rate variation.

Example embodiments of this invention seek to eliminate this disadvantage and to propose fitting a timepiece with a biaxial tourbillon operating around two perpendicular axes.

According to one aspect of the present invention, there is provided a biaxial tourbillon for a timepiece, comprising: a first cage having a first axis of rotation, the first cage containing a balance wheel and an escape pinion; and a second cage having a second axis of rotation; wherein the first cage is housed inside the second cage and the second axis is perpendicular to the first axis.

In example embodiments, the biaxial tourbillon for timepieces, particularly wristwatches, is characterised in that it comprises a first cage containing the balance wheel and the escape pinion, with the cage rotating around an axis and being housed inside a second cage mounted rotatably in recesses, with the second cage rotating around another axis perpendicular to the axis of the first cage.

The cage containing the balance wheel may have a toothed second pinion, which engages with a fixed toothed wheel that is attached to the bottom plate of the timepiece. The second

pinion and the balance wheel staff may have the same axis, corresponding to the axis of rotation of the cage.

The tourbillon may have a second cage that engages with the pinion attached to the centre wheel on an axis perpendicular to the axis of the first cage.

The operation of the biaxial tourbillon may be combined with a retrograde display mechanism indicating the second, or the time in minutes necessary for a complete rotation of the tourbillon, on a linear scale adjacent to the tourbillon.

The drawing shows, as an example, an embodiment of the biaxial tourbillon that is the object of the invention.

In the drawing:

- figure 1 is a perspective view of a biaxial tourbillon,
- figure 2 is a top view of the tourbillon in figure 1 fitted to the back plate of a watch,
- figure 3 is a cross-section of the tourbillon in figures 1 and 2 along the axis of the balance wheel.

The biaxial tourbillon described above with reference to figures 1 to 3 of the drawing was developed for a wristwatch. However, this use is not exhaustive, and the tourbillon can be used in pocket watches or clocks.

When a timepiece is in operation, it can be seen that the rate variation of the timepiece is not the same in a vertical position as it is in a horizontal position. If the balance wheel is adjusted in a horizontal position and the timepiece stays in this position, a rate variation of 0 to 1 second per day can be obtained. If the timepiece is placed in a vertical position, the variation may then reach around 10 seconds per day. Using a tourbillon that rotates on two axes will rectify this rate difference.

The biaxial tourbillon described with reference to figures 1 to 3 of the drawing comprises a conventional tourbillon cage A placed inside another cage B, which in turn rotates on two pivots 1 and 2. The tourbillon cage A pivots
5 rotatably on the axis A1 inside cage B. Taken separately, cage A rotates freely inside cage B.

The second pinion 3 in the tourbillon cage A extends outside the cage. It engages with the third wheel 4 (figure 2), which is attached to the back plate 5 and therefore fixed. The
10 rotation of the outer cage B is therefore carried out by the second pinion 3, which rotates the aforementioned cage on the pivots 1 and 2.

In figure 3, the cage and its drive mechanism are shown, together with a part of the adjustment system, in a cross-section along the shared axis A1 of the cage and the balance
15 wheel. The adjustment system of the wristwatch comprises the balance wheel 10 and the escape pinion 11 and is housed in a cage A, the upper bridge of which has a second pinion 13 with teeth 14 that engage with the fixed wheel 4. The cage A is
20 fixed rotatably onto a roller 15 that is attached to the second wheel 16, which engages with the pinion 11. The cage B is mounted rotatably between two flat jewels 17 and 18 arranged in recesses provided to this end. The pinion 20 rotates around the axis A2.

25 In operation, the following results:

- Rotation around the axis A1 through the engagement of the pinion 13 and the fixed wheel 4;
- Rotation around the axis A2 through the engagement of the pinion 20, attached to the cage B, and the centre
30 wheel 23.

The movement resulting from these two rotations, which take place simultaneously, extends in a three-dimensional space relative to a fixed reference system.

A single-axis tourbillon is to a pocket watch as the
35 tourbillon in figures 1 to 3 is to a wristwatch. That is, where

the former cancels out the adjustment errors in the vertical position, the purpose of the latter is to cancel out the adjustment errors in the vertical and horizontal positions.

5 The purpose of a tourbillon is to cancel out all of the rate errors in the vertical position of the watch (generally a pocket watch). When a tourbillon is placed inside a wristwatch, the average position when worn is horizontal. In this position, the tourbillon has no influence on the rate of the watch. This is why the biaxial tourbillon in figures 1 to 3 cancels out the
10 rate errors in all positions, given that it rotates around two

The biaxial tourbillon described above may be placed under a dial, and it would be possible for the user to study its operation around the two axes A1 and A2. The tourbillon makes a complete rotation in 8 minutes, and studying its
15 operation is interesting and pleasing. The biaxial tourbillon may be combined with a second display and/or a display corresponding to the duration of a complete rotation on a linear scale from 1 to 8 minutes. The displays mentioned above may be advantageously produced by means of a
20 retrograde display mechanism described in Singapore patent application No. _____, entitled "Retrograde Display Mechanism", filed on 26 March 2004 in the owner's name.

CLAIMS:

1. A biaxial tourbillon for a timepiece, comprising:
 - a first cage having a first axis of rotation, the first cage containing a balance wheel and an escape pinion; and
 - a second cage having a second axis of rotation; wherein
 - the first cage is housed inside the second cage and the second axis is perpendicular to the first axis.
2. A biaxial tourbillon according to claim 1, wherein the second cage is mounted rotatably in segments.
3. A biaxial tourbillon according to claim 1 or 2, wherein the first cage further comprises a second pinion in engagement with a fixed wheel.
4. A biaxial tourbillon according to claim 3, wherein the second wheel and the fixed wheel have teeth.
5. A biaxial tourbillon according to claim 3 or 4, wherein the fixed wheel is attached to the back plate of a timepiece.
6. A biaxial tourbillon according to any one of claims 3 to 5, wherein the axis of the second pinion is coaxial with the first axis of rotation.
7. A biaxial tourbillon according to any one of claims 3 to 6, wherein the axis of the second pinion is coaxial with a staff of the balance wheel.
8. A biaxial tourbillon according to any one of the preceding claims, wherein the second cage is mounted rotatably between two jewels.
9. A biaxial tourbillon according to any one of the preceding claims, wherein the second cage engages with a third pinion disposed around the second axis.

10. A biaxial tourbillon according to claim 9, wherein the third pinion is attached to a centre wheel.
11. A biaxial tourbillon according to any one of the preceding claims, in combination a retrograde display mechanism to indicate information on a linear scale adjacent to the tourbillon.
12. A biaxial tourbillon according to claim 11, wherein the information is the time for a complete rotation of the tourbillon.
13. A biaxial tourbillon according to claim 12, wherein the time is in minutes and/or seconds.
14. A biaxial tourbillon according to any one of the preceding claims, wherein the timepiece is a wristwatch.