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BIAXIAL TOURBILLION MECHANISM OF MECHANICAL WATCH

FIELD OF THE INVENTION

The invention relates to a tourbillion mechanism of a mechanical watch, particularly a biaxial tourbillion mechanism of the mechanical watch.

BACKGROUND OF THE INVENTION

A tourbillion in a mechanical watch is a device which is used for decreasing isochronous errors. The device is characterized in that a balance hairspring system and an escapement mechanism are placed in a framework. The device may rotate with the framework while running it against itself and minimize position errors of the watch caused by the gravity, thus improving the accuracy of travel time, wherein the device, in which the axis of the balance hairspring system coincides with the rotational axis of the framework (please refer to “Coaxial rotary escapement mechanism for mechanical watch” with Patent NO. : 200720096902. 5), is called as “Coaxial Tourbillion”. As the rotational axes of the balance hairspring system in the tourbillion framework and the framework itself are coincident, the tourbillion is called as a single-axis tourbillion.

Currently, there is a biaxial tourbillion which may better reduce the position errors caused by the gravity and hence improve the accuracy of the travel time, for example, a biaxial tandem-type tourbillion. The structure is characterized in that: The rotational axis of an inner framework bearing the balance hairspring system is perpendicular to that of an outer framework connected with a supporting framework and crossed with it; the angle between the rotational axis of the inner framework and that of a movement is changed from 0° to 90° continuously; and the rotational axis of the outer framework is perpendicular to the axis of the movement.



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The biaxial tourbillions in the prior art, such as CN Patent Publication No.: 2036454A and US Patent Publication No. : 18060147760A1, are both the biaxial tourbillion, wherein the biaxial tourbillion with Patent Publication No. : CN2036454A is the biaxial tandem-type tourbillion, of which the inner framework adopts a Breguet-type tourbillion mechanism, that is, it adopts an upper-lower bearing manner. The energy input method is as follows: A gear shaft provided at the lower end of the outer framework matches with a contrate gear fixed on a clamp plate. The disadvantage of the structure is that the thickness of the watch is relatively big. As the structure of the outer framework of the tourbillion is in closed type, the thickness of the overall framework is very big. The energy input method facilitates the contrate gear to be made into a ring-shaped gear with very big size, thus further increasing the overall thickness of the movement.

In Publication No.: US18060147760A1, the balance hairspring system and the escapement mechanism are placed in one framework. They rotate on their axes and follow the rotation of the framework at the same time. The rotational axis of the whole framework is perpendicular to the axis of the movement. They also rotate in the direction from 0° to 90°. The disadvantage of the mechanism is in that: The balance hairspring system and the framework of the escapement mechanism only rotate in the direction perpendicular to the axis of the movement, thus no realizing the structure of the biaxial tandem-type tourbillion. Therefore, the errors of the position may be reduced when the watch is under horizontal or vertical state. Meanwhile, as the rotational shaft of the whole framework is supported by a jewelled bearing vertically embedded in a main plate, the processing accuracy of the main plate is required to be high very much, thus influencing the stability of the movement of the whole mechanism. Moreover, a bell-shaped gear is meshed with an escapement contrate gear and directly transmits the axial movement to an escapement. These two tooth-shaped gears are meshed and transmitted unstably, thus influencing the operation of the whole mechanism and hence the accuracy of travel time of the watch.

SUMMARY OF THE INVENTION

The objective of the invention is to overcome the disadvantages of the prior art and provides a biaxial tourbillion with the advantages of a simple structure, good manufacturability and easy processing.

The invention adopts the following technical proposal: A biaxial tourbillion mechanism of a mechanical watch is an open tandem-type structure, comprising a main plate, a third wheel component, a first support component, an inner tourbillion, a second support component and a transmission gear train, wherein the inner tourbillion is provided on a first second bridge; a first support shaft on the first support component and a intermediate wheel in the third wheel component are fixed as one body; a second support shaft on the second support component and a fourth second wheel in the transmission gear train are fixed as one body; the shaft centre of the first support shaft and that of the second support shaft are located on the same horizontal axis; and the third wheel component and the transmission gear train are provided on the main plate.

The first support component comprises a first support shaft, a first jewelled bearing and a first support, wherein the first support shaft is provided on the first jewelled bearing of the first support; the first support shaft forms a square-shaped convex part matched with the inner diameter of the intermediate wheel; the second support component comprises a second support shaft, a second jewelled bearing and a second support, wherein the second support shaft is provided on the second jewelled bearing of the second support; and the first support shaft and the second support shaft are fixed on the first second bridge with a pillar and a bolt, respectively.

The mechanism also comprises a regulated device, wherein the regulated device regulates the axial highness of the second support and further slightly regulates the coaxiality of the second jewelled bearing born by the second support shaft and the first jewelled bearing born by the first support shaft; the regulated device comprises a tapped foot, a bushing, a bearing spring and a regulated nut; the regulated nut and the

bushing are provided on the outer peripheral surface of the tapped foot; and the bearing spring is provided between the regulated nut and the bushing.

The mechanism also comprises the regulated device. The regulated device comprises the tapped foot and the bushing. The highness of the bushing (20) is 0.2—0.5mm.

The third wheel component comprises a first third contrate gear, a third wheel gear and an intermediate wheel, wherein the third wheel gear and the third wheel pinion are riveted as one body and provided on a lower bridge; the intermediate wheel and the third wheel gear are meshed with each other. The transmission gear train comprises a fourth second wheel, a third second wheel gear, a third second wheel pinion, a second second wheel gear, a second second wheel pinion and a first second wheel pinion, wherein the fourth second wheel is fixed on the second support with the bolt; the third second wheel gear and the third second contrate shaft are riveted as one body and provided on the second second bridge; the third second wheel gear and the fourth second wheel are meshed; the second second wheel gear and the second second wheel pinion are riveted as one body; the second second wheel gear and the third second wheel pinion are meshed; the first second wheel pinion and an inner tourbillion are fixed as one body; the first second wheel pinion is meshed with the second second wheel gear; and the second support is fixed on the main plate through the regulated device.

The third wheel gear, the intermediate wheel, the fourth second wheel and the third second wheel gear are all conical gears.

The gear number proportion of the intermediate wheel against the third wheel gear is 1:1; and the gear number proportion of the third second wheel pinion against the first second wheel pinion is 1:1.

The rotational speed of the outer framework is 2-10 minutes/cycle; the rotational speed of the inner tourbillion is 1 minute/cycle; and the gear number proportion of the third second wheel gear against the fourth second wheel is 1: (2-10).

The gear number proportion of the third second wheel gear against the fourth second

wheel is 1: 2. 5 or 1:5.

The invention has the following effective results: As the overall framework is an open-type structure, the thickness of the framework is reduced and hence an assembled watch becomes thinner. As the conical gear is selected to complete the rotational movement of the framework of the tourbillion in a space, the transmission stability is better; and the accuracy of travel time of the watch is higher. As the rotational shaft of the outer framework takes the jewelled bearings on the first support and the second support as support bearings respectively, the processing procedures of the main plate is reduced, and the manufacturability is better, thus improving the processing accuracy. As the bearing shaft of the outer framework can be disassembled wholly, it may be conveniently assembled and maintained. The axial highness of the second support is slightly regulated by the regulated device so that the coaxiality of the supports at the two sides of the outer framework may be effectively guaranteed, thus enhancing the stability of the framework of the tourbillion when the framework is operated in the space

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an axial schematic diagram of Example 1 of the invention;

Figure 2 is a planar schematic diagram of Example 1 of the invention;

Figure 3 is a schematic diagram of Example 1 of the invention; and

Figure 4 is an axial schematic diagram of Example 2 of the invention.

REFERENCE NUMERALS OF DRAWINGS

1: Main plate

2: Lower bridge

3a: Third Wheel Pinion

3b: Third Wheel Gear

4: Intermediate Wheel

5: First Support Shaft

6: First Jeweled Bearing

7: First Support

8: Pillar

9: First second bridge

10: Second Support Shaft

11: Second Jeweled Bearing

12: Second Support

13: Fourth Second Wheel

14a: Third Second Wheel Gear

14b: Third Second Wheel Pinion

15a: Second Second Wheel Gear

15b: Second Second Wheel Pinion

16: First Second Wheel Pinion

17: Inner Tourbillion

18: Second Second Bridge

19: Tapped foot 20: Bushing

21: Bearing Spring

22: Regulated Nut

DETAILED DESCRIPTION OF THE EMBODIMENTS

The invention is further described with the combination of the drawings and the embodiments in the followings:

As shown in figures 1-3, in Example 1, a biaxial tourbillion mechanism of a mechanical watch of the invention is an open-type structure, comprising a main plate 1, a third wheel component, a first support component, an inner tourbillion 17, a first second bridge 9, a second support component, a transmission gear train and a regulated device, wherein the inner tourbillion 17 is provided on the first second bridge 9; the first support component and the second support component are provided on the main plate 1; the third wheel component is provided on a lower bridge 2; and the transmission gear train is provided on a second clamp plate.

The third wheel component comprises a first third contrate gear 3a, a third wheel gear 3b and an intermediate wheel 4. The third wheel gear 3b and the third wheel pinion 3a are riveted as one body and provided on a lower bridge 2. The third wheel gear 3b is a conical gear. The intermediate wheel 4 and the third wheel gear 3b are meshed with each other. The second third wheel gear 3b is a conical gear. The inner diameter of the intermediate wheel 4 is a square-shaped hole. The square-shaped hole and a square-shaped convex part of the first support shaft 5 are matched with each other and fixed as one body with a pin. The screwing direction of a pin coincides with the rotational direction of the intermediate wheel 4. The gear number proportion of the intermediate wheel 4 against the third wheel gear 3b is 1:1. The first support component comprises a first support shaft 5, a first jewelled bearing 6 and a first support 7. The first support shaft 5 is provided on the first jewelled bearing 6 of the first support 7. The first support shaft 5 is fixed on the first second bridge 9 through a pillar 8 and the pin. The second support component comprises a second support shaft 10, a second jewelled bearing 11 and a second support 12. The second support shaft 10 is provided on the second jewelled bearing 11 of the second support 12. The first support shaft 5 and the second support shaft 10 are fixed on the first second bridge 9 with a pillar 8 and a bolt, respectively. The transmission gear train comprises a fourth

second wheel 13, a third second wheel gear 14a, a third second wheel pinion 14b, a second second wheel pinion 15b and a first second wheel pinion 16. The fourth second wheel 13 is fixed on the second support 12 with a bolt. The fourth second wheel 3b is a conical gear. The third second wheel gear 14a and the third second contrate shaft 14b are riveted as one body and provided on the second second bridge 18. The third second wheel gear 3b is a conical gear. The third second wheel gear 14a and the fourth second wheel 13 are meshed. The second second wheel gear 15a and the second second wheel pinion 15b are riveted as one body.

The second second wheel gear 15a and the third second wheel pinion 14b are meshed. The first second wheel pinion 16 and the inner tourbillion 17 are fixed as one body; The structure of the inner tourbillion 17 is not described in details. Please refer to Patent No. : 200720096902. 5 of “Coaxial rotary escapement mechanism for mechanical watch”, wherein the rotational speed of the tourbillion is 1 minute/cycle. The first second wheel pinion 16 is meshed with the second second wheel gear 15a. The gear number proportion of the third second contrate shaft 14b against the first second contrate shaft 16 is 1: 1. The gear number proportion of the fourth second wheel 13 against the third second wheel gear 14a is 2. 5 times or 5 times as high as the rotational speed of the outer framework. This value represents that the rotational speed of the outer framework is 2.5 minutes/cycle or 5 minutes/cycle. The selectable scope of the value is 2-10. The rotational speed of the inner tourbillion is 1 minute/cycle. Therefore, the gear number proportion of the third second wheel gear 14a against the fourth second wheel 13 is 1: (2-10). The second support 12 is fixed on the main plate 1 through the regulated device. The regulated device regulates the axial highness of the second support 12 and further slightly regulates the coaxiality of the second jewelled bearing 11 born by the second support shaft 10 and the first jewelled bearing 6 born by the first support shaft 5. The regulated device comprises a tapped foot 19, a bushing 20, a bearing spring 21 and a regulated nut 22. The regulated nut 22 and the bushing 20 are provided on the outer peripheral surface of the tapped foot 19. The bearing spring 21 is provided between the regulated nut 22 and the bushing 20.

As shown in figure 4, in Example 2, the second support 12 is fixed on the main plate through the tapped foot 19, the bushing 20 and the bolt. The thickness of the bushing 20 may be selected reasonably from the scope of 0.2-0.5mm. The axial highness of the second support 12 is regulated mainly through the adoption of the different highness of the bushing 20, so that the coaxiality of the second jewelled bearing 11 born by the second support shaft 10 and the first jewelled bearing 6 born by the first support shaft 5 is further regulated. As other structures all are the same as those in Example 1, they will not be described in more details here.

The overall framework of the invention adopts an open type structure. As the inner tourbillion selects a flight-type tourbillion structure, the overall thickness of a movement is reduced. The number of teeth of the transmission gear train connected with the inner tourbillion may be selected from the scope of 2-10 according to design requirement. 2, 5 or 10 is preferably selected as the number of the teeth of a power input gear of the outermost end to determine the rotational speed of the outer framework. Firstly, this set method is better conducive to the serialization of the invention. Secondly, the invention completes the rotational movement of the framework of the tourbillion in the space through a conical gear. As the transmission of the conical gear has the advantages of stable transmission and high strength, it is very suitable for the movement of the framework of the tourbillion in the mechanical watch in the space and may guarantee the stability of the transmission, thus ensuring the accuracy of travel time of the mechanical watch. Thirdly, the rotational shaft of the outer framework in the invention respectively takes the jewelled bearings on the first and the second supports as the support bearings and does not adopt the structure where the main plate is punched and embedded with the jewelled bearing, thus reducing the processing procedures of the main plate, improving the processing accuracy of parts, having sound manufacturability, and improving the accuracy of travel time of the watch. Fourthly, this bearing shaft of the outer framework may be set so as to be disassembled overall easily, thus

having easy assembly, easy maintenance, simplicity and convenience. Finally, the second support in the invention adopts an adjustable nut structure. That is, the axial highness of the second support is slightly regulated by the regulation of a nut, thus conveniently regulating the coaxiality of the supports at the two sides of the outer framework in the invention, and guaranteeing the stability of the framework of the tourbillion when it is moved in the space, and the accuracy of travel time of the watch. The working procedures of the invention are explained as follows:

The transmission gear train of the invention transmits the energy of a movement to a first third contrate gear 3a and drives it to be rotated in anticlockwise. The first third wheel gear 3b drives the intermediate wheel 4 to be rotated in the clockwise. As the intermediate wheel 4 and the outer framework in the invention are fixed as one body, the outer framework and the inner tourbillion are driven to be rotated in the anticlockwise. It shall be noted that the rotational axis of the outer framework is perpendicular to the axis of the movement. The third second wheel gear 14a, driven by the outer framework, moves around the fourth second wheel 13 fixed on the second support 12 and has orbit revolution in clockwise while has autorotation in the clockwise. The third second wheel pinion 14b, through the second second wheel gear 15a, drives the first second wheel pinion 16 to be rotated in the clockwise. As the first second contrate shaft 16 and the inner tourbillion 17 are fixed as one body, energy is input into the balance hairspring system of the inner tourbillion 17 and the system starts to rotation. The inner tourbillion is rotated at the speed of 1 minute/cycle. The angel of the axis of the rotational shaft of the inner tourbillion against the axis of the movement is changed from 0° to 90°. The axis of the rotational shaft of the inner tourbillion is perpendicular to that of the outer framework and crossed with it. The value of the rotational speed of the outer framework is 2.5 or 5. This value represents that the rotational speed of the outer framework is 2.5 minutes/cycle or 5 minutes/cycle. The time, during which the outer framework is rotated by one cycle, may last 2-10 minutes.

It is worth to note that the example adopts a coaxial type tourbillion but the protection scope of the invention is not limited to the abovementioned embodiments. According to the basic technical concept of the invention, the transmission also may be carried out with substantially the same structures. The eccentric tourbillion still may realize the objective of the invention. The implementation method, which can be associated by the skilled in the prior art who may obtain the method without creative labor, belongs to the protection scope of the invention.

CLAIMS

1. A biaxial tourbillion mechanism of a mechanical watch, wherein the biaxial tourbillion mechanism is an open tandem-type structure, comprising a main plate (1), a third wheel component, a first support component, an inner tourbillion (17), a second support component and a transmission gear train, wherein the inner tourbillion (17) is provided on a first second bridge (9); a first support shaft on the first support component and a intermediate wheel (4) in the third wheel component are fixed as one body; a second support shaft on the second support component and a fourth second wheel in the transmission gear train are fixed as one body; the shaft centre of the first support shaft and that of the second support shaft are located on the same horizontal axis; and the third wheel component and the transmission gear train are provided on the main plate (1).

2. The biaxial tourbillion mechanism of the mechanical watch according to claim 1, wherein the first support component comprises a first support shaft (5), a first jewelled bearing (6) and a first support (7), wherein the first support shaft (5) is provided on the first jewelled bearing (6) of the first support (7); the first support shaft (5) forms a square-shaped convex part matched with the inner diameter of the intermediate wheel (4); the second support component comprises a second support shaft (10), a second jewelled bearing (11) and a second support (12), wherein the second support shaft (10) is provided on the second jewelled bearing (11) of the second support (12); and the first support shaft (5) and the second support shaft (10) are fixed on the first second bridge (9) with a pillar (8) and a bolt, respectively.

3. The biaxial tourbillion mechanism of the mechanical watch according to claim 1 or 2, wherein the mechanism also comprises a regulated device; the regulated device regulates the axial highness of the second support (12) and further slightly regulates the coaxiality of the second jewelled bearing (11) born by the second support shaft (10) and the first jewelled bearing (6) born by the first support shaft (5); the regulated

device comprises a tapped foot (19), a bushing (20), a bearing spring (21) and a regulated nut (22), wherein the regulated nut (22) and the bushing (20) are provided on the outer peripheral surface of the tapped foot (19); and the bearing spring (21) is provided between the regulated nut (22) and the bushing (20).

4. The biaxial tourbillion mechanism of the mechanical watch according to claim 1 or 2, wherein the mechanism also comprises the regulated device; the regulated device comprises the tapped foot (19) and the bushing (20); and the highness of the bushing (20) is 0.2—0.5mm.

5. The biaxial tourbillion mechanism of the mechanical watch according to claim 1, wherein the third wheel component comprises a first third contrate gear (3a), a third wheel gear (3b) and an intermediate wheel (4), wherein the third wheel gear (3b) and the first third contrate gear (3a) are riveted as one body and provided on a lower bridge (2); the intermediate wheel (4) and the third wheel gear (3b) are meshed with each other; the transmission gear train comprises a fourth second wheel (13), a third second wheel gear (14a), a third second wheel pinion (14b), a second second wheel gear (15a), a second second wheel pinion (15b) and a first second wheel pinion (16), wherein the fourth second wheel (13) is fixed on the second support (12) with the bolt; the third second wheel gear (14a) and the third second wheel pinion (14b) are riveted as one body and provided on the second second bridge (18); the third second wheel gear (14a) and the fourth second wheel (13) are meshed; the second second wheel gear (15a) and the second second wheel pinion (15b) are riveted as one body; the second second wheel gear (15a) and the third second wheel pinion (14b) are meshed; the first second wheel pinion (16) and an inner tourbillion (17) are fixed as one body; the first second wheel pinion (16) is meshed with the second second wheel gear (15a); and the second support (12) is fixed on the main plate (1) through the regulated device.

6. The biaxial tourbillion mechanism of the mechanical watch according to claim 1, wherein the third wheel gear (3b), the intermediate wheel (4), the fourth second wheel (13) and the third second wheel gear (14a) are all conical gears.

7. The biaxial tourbillion mechanism of the mechanical watch according to claim 1, wherein the gear number proportion of the intermediate wheel (4) against the third wheel gear (3b) is 1:1; and the gear number proportion of the third second wheel pinion (14b) against the first second wheel pinion (16) is 1:1.
8. The biaxial tourbillion mechanism of the mechanical watch according to claim 5, wherein the rotational speed of the outer framework is 2-10 minutes/cycle; the rotational speed of the inner tourbillion is 1 minute/cycle; and the gear number proportion of the third second wheel gear (14a) against the fourth second wheel (13) is 1: (2-10).
9. The biaxial tourbillion mechanism of the mechanical watch according to claim 8, wherein the gear number proportion of the third second wheel gear (14a) against the fourth second wheel (13) is 1: (2. 5) or 1:5.