(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 491 463 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
09.07.2014 Bulletin 2014/28

(21) Application number: **10795603.9**

(22) Date of filing: **15.10.2010**

(51) Int Cl.:
G04B 15/08 *(2006.01)* ***G04B 17/06*** *(2006.01)*

(86) International application number:
PCT/BG2010/000018

(87) International publication number:
WO 2011/047449 (28.04.2011 Gazette 2011/17)

(54) **LEVER ESCAPEMENT MECHANISM**

ANKERHEMMUNGSMECHANISMUS

MÉCANISME D'ÉCHAPPEMENT À ANCRE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **19.10.2009 BG 11049609**

(43) Date of publication of application:
29.08.2012 Bulletin 2012/35

(73) Proprietor: **Blagoev, Lyuboslav Krumov**
4000 Plovdiv (BG)

(72) Inventor: **Blagoev, Lyuboslav Krumov**
4000 Plovdiv (BG)

(74) Representative: **Takova, Simona Dragomirova**
Blvd. "Aleksandar Stamboliyski" No. 30
entr. A, 2 Floor
1301 Sofia (BG)

(56) References cited:
WO-A2-2006/067597 **FR-A- 322 419**
US-A- 22 791

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 491 463 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Technical field

[0001] The invention relates to a lever escapement mechanism, which can find its application in fine mechanics and the clockworks of wrist and pocket watches and stationary clocks.

Prior art

[0002] Most of the contemporary mechanical watches use the so called lever escapement mechanism for accurate time measurement. This is evident from the reference section material of this report - 1, 2, 3.

[0003] The mechanism consists of an escape wheel and an lever (anchor) connected with a balance wheel. Its structure consists of a balance wheel with a spiral spring barrel connected to it performs fluctuating motions with strictly defined frequency. Radial towards the axis of the balance wheel there is a pallet attached which controls the lever by its operating fork, getting at the same time a force impulse by it, thus maintaining its fluctuating movement. The lever itself controls the rotation of the escape wheel and it defines the speed of movement of the whole clockwork mechanism. The accuracy of the functioning of the clockwork is defined by the accuracy of the balance wheel rotation.

[0004] Another example of prior art is given by the document FR 322 419.

[0005] In the above described solution there are some essential disadvantages:

1. The accuracy of the balance wheel rotation in static position depends on the space orientation of the spiral spring barrel towards the gravitation force. This leads to faster or slower functioning of the clock.

2. The accuracy of the rotation of the balance wheel changes under the impact of external forces, when the mechanism is not in a static position. During its random motion in space, there emerge forces, some of which are directed in a way that they aim at either accelerating or slowing down the rotation of the balance wheel. This in its part makes the clock works faster or slower.

3. When these disturbing forces exceed a defined value, they can considerably alter the preliminary defined amplitude and frequency of the balance wheel and lead to a durable change in the accuracy of the clockwork operation.

[0006] A one-lever escapement mechanism with two balance wheels is known.

[0007] Its first public display took place in March 2009 at the annually held international exhibition in Basel, Switzerland. The wrist watch of Rudis Sylva - Oscillateur Harmonieux was equipped with it. The Finnish watchmaker Mika Rissanen, who works for the same company, is the inventor of the mechanism. In the structure of this watch a second balance wheel is put in, which is set in motion by the first one and rotates in the opposite direction (towards the first balance wheel). The transmission of the moment of rotation is accomplished by the periphery of the two balance wheels which are shaped as click wheels and their clicks are of a triangle shape.

[0008] At first sight, the mechanism proposed hereafter is similar to the one used by Mr. Mika Rissanen, but the similarity, however, starts and ends with the insertion of a second balance wheel, which rotates in synchrony with the first one but in opposite direction.

[0009] Actually, in the present proposal there are some essential differences of principle and also some advantages in comparison with the mechanism invented by Mr. Rissanen.

[0010] They are as follows:

1. Both of the balance wheels rotate entirely freely;
2. Each one is set independently into motion by the lever;
3. Both of the spiral spring barrels wind and unwind simultaneously, thus ensuring completely synchronized rotation of the two balance wheels;
4. An interaction between the balance wheels occurs only if a strong enough external disturbing force exists;
5. The synchronizing pins only neutralize the impact of the external forces;
6. There aren't permanent disturbances of the balance wheels movement caused by the inevitable inaccuracy in the manufacturing and the joint functioning of two click wheels;
7. There aren't permanent disturbances in the movement of the two balance wheels caused by the transmission of a constantly changing in size and direction moment of rotation from the one balance wheel to the other. Respectively there aren't fulcrum reactions in the bearings of the two balance wheels caused by it.

Description of the Invention

[0011] The invention aims at creating a lever escapement mechanism which should eliminate the above mentioned disadvantages:

1. To minimize the impact of external, disturbing forces on the functioning of the balance wheel to preliminary defined limits.
2. To neutralize the impact of the gravitation force on the accuracy of the balance wheel functioning.

[0012] The task has been solved by creating a lever escapement mechanism, where to the existing balance wheel with the spiral spring barrel attached to it, an additional, second balance wheel, identical to the first one, has been mounted.

[0013] The second balance wheel has been equipped with a spiral spring barrel as well, whose parameters are equal to the parameters of the existing one but is a mirror image and is rotated to 180 degrees towards it.

[0014] Both of the spiral spring barrels are situated in one and the same plane.

[0015] Radial towards the axis of the second balance wheel there is also a pallet attached which contacts with the lever (anchor) by a second operating fork.

[0016] The axis of the lever is parallel to the axes of the two balance wheels and is set on one straight line with them.

[0017] On one side of the lever there is a fork for the pallet of the first balance wheel and on the other side there is a second operating fork for the pallet of the second balance wheel. The distance between the lever axes to each of the pallets is equal.

[0018] The lever with the help of two clicks (pallets) controls the rotation of the escape wheel and the escape wheel determines the speed of the whole clockwork mechanism. On the operating plane of the lever there are two restricting pins mounted, which limited its movement.

[0019] Along the periphery of the two balance wheels, are mounted synchronizing pins (11) which (the pins) confine the angular shifting of one of the balance wheel towards the other. In this way the angular difference "a" in the location of the two pallets (3), (9) towards the two forks (4), (10) is confined, thus ensuring their simultaneous presence in their operating area.

[0020] The angular difference "a" is defined by the looseness of the synchronizing pins. The looseness can be altered according to the different constructional parameters chosen.

[0021] Both of the balance wheels work in one and the same plane and have equal technical parameters, as the second balance wheel rotates in synchrony with the first one but in the opposite direction (in anti-phase).

[0022] The two equal balance wheels carry out a contact between each other with the help of synchronizing pins but only when there is a strong enough torque moment, created by external disturbing forces. At the moment when the contact between the synchronizing pins is carried out, the arising forces are equal in size but opposite in direction and mutually neutralize each other.

[0023] The advantages of the so designed lever escapement mechanism with two balance wheels are:

1. The deviations from the normal functioning are preliminary limited and the mechanism is protected against durable changes of the amplitude and frequency of the balance wheel rotation.
2. The impact of the gravitation force on the accuracy of the mechanism functioning has been eliminated.
3. The preliminary defined parameters are automatically restored.

Descriptions of the enclosed figures

[0024]

Figure 1 - An example of a lever escapement mechanism is shown.
Figure 2 - The angle "a" is shown in principle.

An example for the execution of the invention

[0025] In accordance with the description and the enclosed figures, the execution of the lever escapement mechanism as a model has the following structure:

The proposed mechanism is, in fact, a classical lever escapement mechanism where, to the existing balance wheel (1), with a spiral spring barrel (2) connected to it, an additional, second balance wheel (7), identical to the existing one has been mounted. Radial towards the axis of the first balance (1) there is a pallet (3) attached which contacts with the lever (anchor) (5) by means of an operating fork (4).

[0026] The second balance wheel (7) has a spiral spring barrel (8), which is a mirror image and is rotated to 180 degrees towards the spiral spring barrel (2) of the first balance wheel (1). Both of the spiral springs (2), (8) are located on one and the same plain.

[0027] Radial towards the axis of the second balance wheel (7), a pallet (9) is attached, which by means of the second operating fork (10) contacts with the lever (5). Lever (5) is mounted on an axis, which is parallel to the axis of the two balance wheels (1), (7) and is set on one straight line with them, as on the one hand, the lever (5) ends with an operating fork (4) for the basic balance (1), and on the other hand, ends with a second operating fork (10) for the second balance (7).

[0028] The lever (5) and the two operating forks (2), (10) are located on one and the same plane. On the same lever (5) plane, the escape wheel (6) is situated. Lever (5) has two clicks (pallets) by which it controls the functioning of the escape wheel (6) through which it gets force impulses which it transmits to both of the balance wheels.

[0029] There are two pins (12) mounted on the same plain, whose function is to limit the motion of the lever.

[0030] Along the periphery of the two balance wheels (1) and (7), there are synchronizing pins (11) mounted, which restrict the angular shift between them and respectively between pallet (3) and pallet (9).

[0031] The two balance wheels (1) and (7) operate on one and the same plane, and have equal technical parameters, as the second balance wheel (7) rotates in synchrony with the first one (1) but in the opposite direction (in anti-phase).

[0032] The two identical balance wheels (1) and (7) make contact between each other due to the synchronizing pins (11) only when there is a torque moment big enough, caused by the impact of the external disturbing forces.

[0033] The shown on figure 2 preliminary defined looseness, equal to angle "a", defines the maximum of admissible angular deviation from the correct operation of the balance wheels (1), (7) and guarantees the simultaneous presence of the two pallets (3), (9) in the operating areas of the two forks (2), (10) of the lever (5).

How to apply the invention

[0034] In accordance with the invention the lever escapement mechanism functions in the following way:

The lever (5) by its two forks (4), (10) contacts with the pallet (3), (9) respectively of the first (1) and the second (7) balance wheels, thus simultaneously transmitting to them equal in size and opposite in direction force impulses. Thus the two balance wheels (1), (7) rotate in synchrony, but in opposite directions.

[0035] If there are no external disturbances they rotate entirely freely, without contacting each other.

[0036] This is guaranteed by the looseness left between the synchronizing pins (11), positioned along the periphery of the two balance wheels. This looseness is marked in figure 2 by angle "a".

[0037] The impact of external disturbing force will be simultaneous on both of the balance wheels (1), (7). The torque moment of the force will be equal in size and direction for both of the balance wheels (1), (7).

[0038] This torque moment will simultaneously accelerate the motion of one balance wheel and slow down the motion of the other one.

[0039] The relative motion velocity between the two balance wheels (1), (7) will change; one of the wheels will rotate additionally towards the other and the synchronizing pins (11) will touch.

[0040] Thus the arisen disturbing moments will mutually neutralize.

[0041] Although between the two pallets (3), (9) there will be a certain angular shift, after their entering in the operating area and after their contact with the forks (4), (10) and after getting a force impulse by the lever (5) they will align their position.

[0042] Getting out of contact with the forks (4), (10), the pallets (3), (9) and respectively the two balance wheels (1), (7) will still have equal angular acceleration and velocity, i.e. they will rotate in synchrony but in opposite directions (in anti-phase).

[0043] To compensate the change in the duration of time intervals measured by the mechanism, which is caused by the different orientation of the plane in which it works towards the gravitation force the following, has been done:

The spiral spring barrel (8) of the second balance wheel (7) is a mirror image and is rotated to 180 degrees towards the spiral spring barrel (2) of the first balance wheel (1) and is located on the same plane.

[0044] With such orientation of the two spring barrels (2), (8) they will wind and unwind simultaneously, though the two balance wheels (1), (7) rotate in opposite directions.

[0045] The placement of the spring barrels (2), (8) at 180 degrees to each other on their operating plain defines the opposite impact to the gravitation force towards each of them.

[0046] In this way they will jointly eliminate the impact of gravitation force on the frequency of their own oscillations.

References:

[0047]

1. "Taschenuhren"-Von der Halsuhr zum Tourbillon, Meis Reinhard 5te. Auflage - Munchen: Callwey 1994. ISBN 3-7667-1133-4.

2. "ЧАСАЫ"-Международный часовой журнал 6p.3/2002r. MockBa ООО" Издательство Премьера" п.к. 129085, пр. Ольминского 3А факс 0095 216 01 91, E-mail: watch@astrel.ru. ISSN 1681-5181.

3. Механични часовници - Автори: А. Х.Фендян, Е. Л.Чичов, издателство Техника 1959 г., София.

Claims

1. A lever escapement mechanism, consisting of a first balance wheel (1) with a spiral spring barrel (2) connected to it, which is radially positioned towards the axis of said balance wheel (1), which has a first pallet (3) attached to it arranged to be in contact with a lever (5) through an operating fork (4); the lever (5) being arranged to control the escape wheel (6); on the plane of lever (5) there are provided restricting pins (12); wherein an additional, second balance wheel (7) is mounted, which is identical to the first one; both the spiral spring barrels (2, 8) being located on one and the same plane; wherein along the periphery of both of the balance wheels (1, 7) there are synchronizing pins (11) positioned; **characterised in that**,
to the second balance wheel (7) a mirror image spiral spring barrel (8) is fixed, which is rotated of 180 degrees towards the spiral spring barrel (2) of the first balance wheel (1); and wherein, radially towards the axis of the second balance wheel (7) there is a second pallet (9) fixed, which, by means of a second operating fork (10) is arranged to be in contact with the lever (5) whose axis is parallel to the axes of the two balance wheels and is set on one straight line with them.

2. Lever escapement mechanism according to claim 1, being **characterized by** the fact that the basic first pallet (3) and the additional second pallet (9) are arranged in such a way that, there might be some angular shift not bigger than angle "a", which angle is preliminary defined by the looseness between the synchronizing pins (11), the two pallets (3, 9) being positioned at equal distance from the axis of lever (5).

Patentansprüche

1. Ankerantriebswerk bestehend aus einer ersten Unruh (1) mit Spiralfeder (2), radial zur Achse der Unruh (1) ist eine erste Palette (3), die eingestellt ist, mittels Arbeitsgabel (4) mit dem Anker (5) zu kontaktieren; der Anker (5) ist eingestellt, das Ankerrad (6) zu steuern; in der Fläche des Ankers (5) gibt es Begrenzungsstifte (12); dort ist zusätzlich eine zweite Unruh (7) montiert, die identisch der ersten ist; die beiden Spiralfeder (2) und (8) liegen in ein und der gleichen Fläche; wo auf der Peripherie der beiden Unruhen (1) und (7) Synchronsierungsstifte (11) positioniert sind; **Gekennzeichnet dadurch, dass** zur zweiten Unruh (7) eine spiegelbildlich gewendete Spiralfeder montiert ist, die um 180° gegenüber der Spiralfeder (2) der ersten Unruh (1) gedreht ist, wo eine zweite Palette (9) radial zur Achse der zweiten Unruh (7) montiert ist, die mittels einer zweiten Arbeitsgabel (10) mit dem Anker (5) kontaktiert, dessen Achse paralell zu den Achsen der beiden Unruhen ist und mit ihnen in einer geraden Linie liegt.

2. Ankerantriebswerk lt. Anspruch 1, **gekennzeichnet dadurch dass** die erste Grundpalette (3) und die zusätzliche zweite Palette (9) so positioniert sind, dass zwischen ihnen eine Winkelverschiebung, jedoch nicht größer als Winkel α, existieren kann, welcher Winkel α durch das Spiel zwischen den Synchronisierungsstiften (11) vorbestimmt ist, indem die beiden Paletten (3) und (9) auf einem gleichen Abstand von der Achse des Ankers (5) positioniert sind.

Revendications

1. Mécanisme à ancre de démarrage composé d'une roue d'échappement (1), avec un ressort en spirale joint à elle (2), radialement par rapport à l'axe de la roue d'échappement (1) il y a une palette fixée (3), qui est en contact avec l'ancre (5) par la fourche de fonction (4); l'ancre (5) dirige la roue à encre (6); dans le plan de l'ancre (5) il y a des goupilles réductrices (12); ou est montée une deuxième roue d'échappement supplémentaire (7) identique à la première; les deux ressorts en spirale (2) et (8) sont disposes dans le même plan; ou, sur la périphérie des deux roues d'échappement (1) et (7) sont posées des goupilles de synchronisation (11); **se caractérisant par, le fait qu'**à la deuxième roue d'échappement (7) il y a un ressort (8) en spirale monte en image miroir, tourné à 180° par rapport au ressort en spirale (2) de la première roue; et où radialement par rapport à l'axe de la deuxième roue (7) est montée une deuxième palette (9) qui, par l'intermédiaire de la deuxième fourche de fonction (10) entre en contact avec l'ancre (5) dont l'axe est parallèle aux axes des deux roues d'échappement et cet axe se trouve sur la même ligne droite que les roues.

2. Mécanisme de démarrage a ancre, selon la revendication 1 qui se **caractérise par le fait que** la première palette principale (3) et la deuxième palette ajoutée (9) sont arrangées de la façon qu'entre elles il existe un déplacement d'angle, mais pas plus grand que l'angle α, et l'angle α est préalablement déterminé par le jeu entre les goupilles de synchronisation (11); les deux palettes (3) et (9) étant positionnées à des distances égales par rapport à l'axe de l'ancre (5).

Figure 1

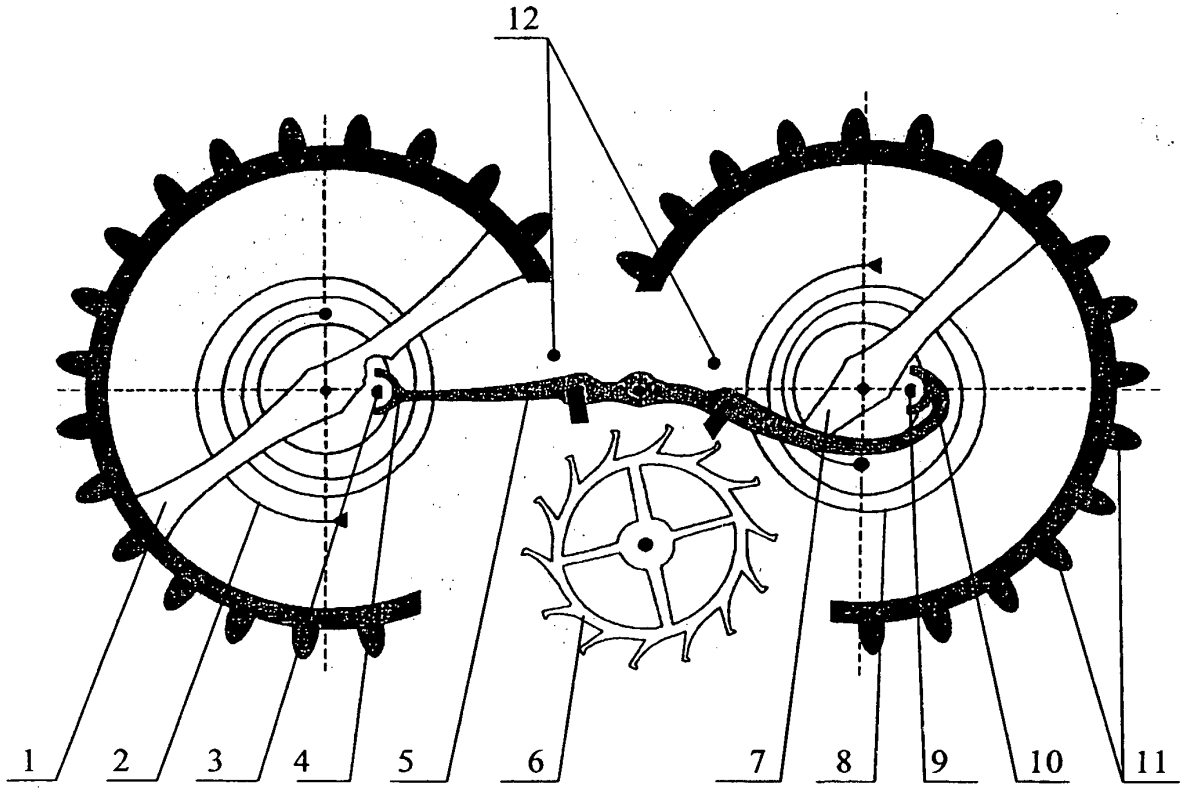
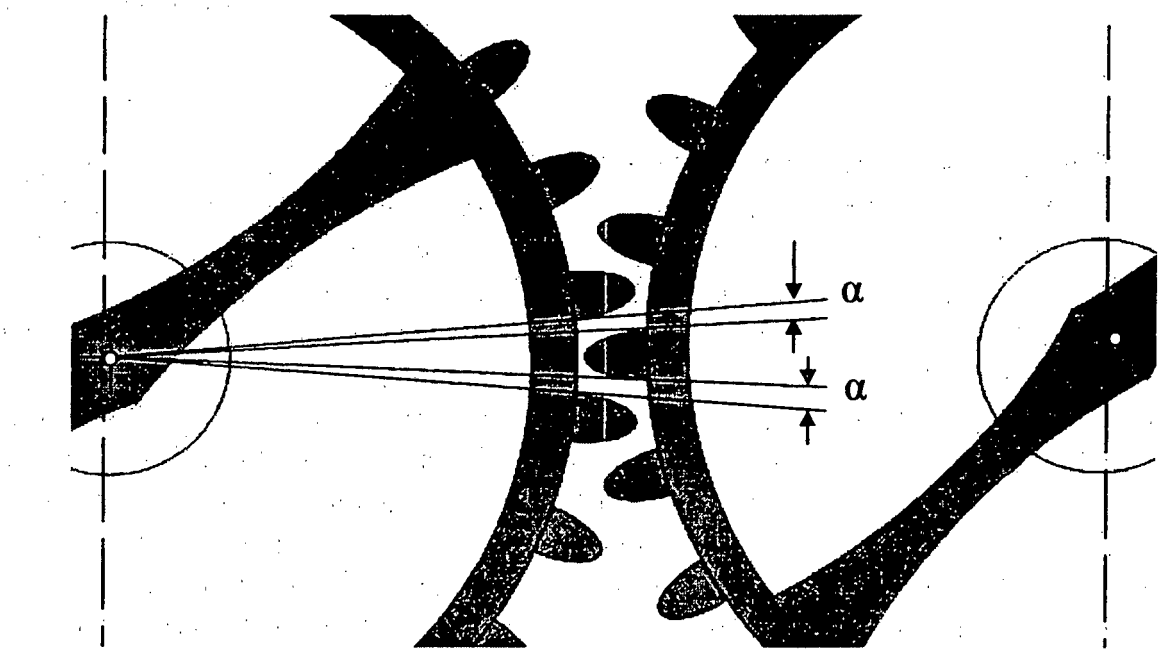


Figure 2



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- FR 322419 **[0004]**

Non-patent literature cited in the description

- Taschenuhren. 1994 **[0047]**