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(54) METHOD OF ASSEMBLING A MOVEMENT FOR A WATCH

(57) The invention relates to a method of and a kit for assembling a movement (35) for a watch, in particular a wristwatch, which method comprises the steps of:
- providing a base plate (1) that defines positions (for accommodating a mainspring (2), a gear train (3-5), an escape wheel, an anchor, and an oscillator,
- mounting an oscillator (20) having a natural frequency of at least 8 Hz in and/or on the base plate (1), and
- mounting at least one reduction gear (6) between the mainspring and the oscillator (20).

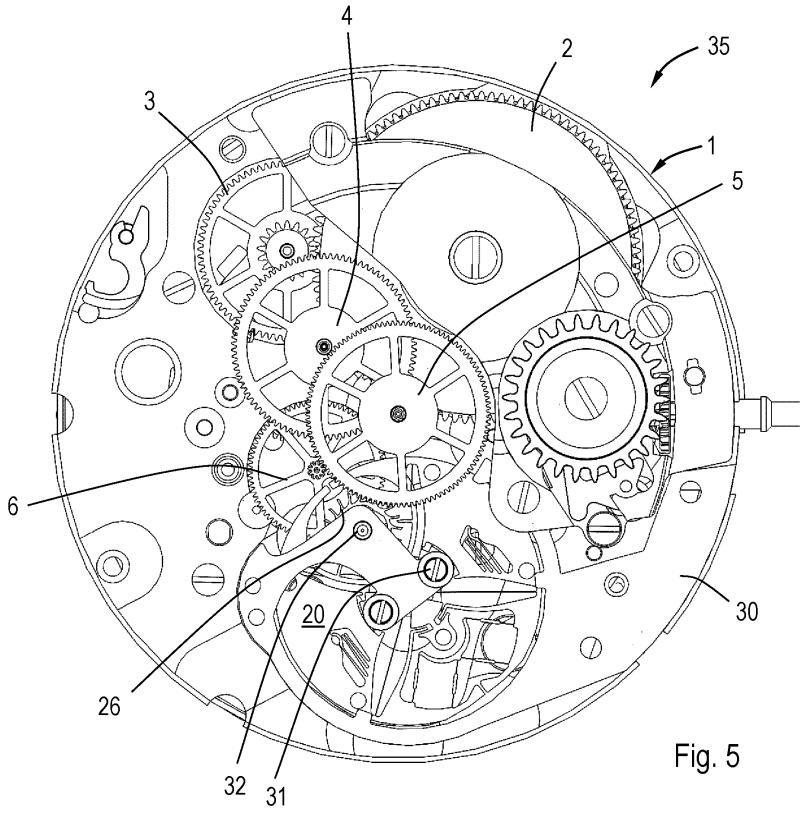

Fig. 5

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Description

[0001] The invention relates to a method of assembling a movement for a watch, in particular a wristwatch, which method comprises providing a base plate, also known as pillar plate, that defines positions for the mainspring, drive train, escapement and balance, e.g. (circle) cylindrical recesses and/or bearings, in particular jewels, also known as rubies. The method comprises mounting a mainspring, typically a so-called barrel containing a spiral spring and having a geared circumference, a gear train, typically including the so-called center wheel including a center wheel pinion, third wheel and pinion, and fourth wheel and pinion, an escape wheel including an escape wheel pinion, an anchor, traditionally often a so-called Swiss anchor or Swiss lever, and an oscillator in the base plate. The center wheel typically rotates once per hour and holds the minutes hand, the fourth wheel typically rotates once per minute and typically holds the seconds hand.

[0002] Many watch brands and manufacturer of watch movements or ebauches have movements that are produced in large numbers and that over many years, sometimes decades, have proven to be reliable, accurate, and/or cost efficient.

[0003] The present invention has as an objective to provide a method and kit that enables upgrading, e.g. modernizing, existing movements and movement designs as well as including such upgrades in recently or newly designed movements.

[0004] To this end, the method according to the present invention comprises

- mounting, e.g. seating or placing, preferably between bearings and/or shock protection systems, an oscillator having a natural frequency of at least 8 Hz in and/or on the base plate, and
- mounting at least one reduction gear, such as a (coaxial) reduction wheel and pinion, between the mainspring and the escape wheel, preferably between the gear train, in particular the fourth or seconds wheel, and the escape wheel.

[0005] In an embodiment, the method comprises

- placing the at least one reduction gear, directly or indirectly, e.g. via an adaptor as will be explained in more detail below, at least partially at the position that was originally intended for an escape wheel, e.g. in the (lower) bearing intended for the escape wheel,
- placing an escape wheel in the base plate, and/or
- securing the escape wheel, and preferably also the oscillator, operatively in place by means of a bridge over the escape wheel and optionally over the oscillator.

[0006] In an embodiment, the base plate defines a position for an anchor, such as a so-called Swiss anchor or Swiss lever, and the escape wheel is placed in that position, in particular in the (lower) bearing in the base plate originally intended for the anchor, now used for the escape wheel.

[0007] An embodiment comprises the step of mounting, e.g. by screwing or press-fitting, an adaptor in and/or on the base plate and securing the oscillator, and optionally anchor teeth, the reduction gear, and/or the escape wheel in and/or on the adaptor.

[0008] The adaptor enables shifting or optimizing the position, in the plane of the movement and/or in the height direction (perpendicular to the plane of the movement), of the oscillator e.g. relative to the base plate and/or the reduction gear.

[0009] The oscillator can be mounted in and/or on the movement or the adaptor by e.g. screws and/or conical or cylindrical alignment pins.

[0010] Another embodiment comprises clamping the oscillator, e.g. by means of at least one fixed reference point and at least one resilient element to urge a mounting part of the oscillator onto the at least one reference point, to the base plate or to the adaptor.

[0011] With the method according to the present invention existing movements and movement designs can be upgraded, modernized, retrofitted, and/or serviced or new movements can be manufactured to obtain a high frequency movement, optionally also providing low torque at the escape wheel which in turn enables longer autonomy (*réserve de march*). When the method is applied for building a new movement on an existing, mainstream base plate or base plate design, the reduction wheel and pinion, the high-frequency oscillator and optionally the anchor and/or adaptor, are installed instead of the originally intended components, such as an escape wheel, anchor, and balance and hairspring that where originally designed and offered for the movement. In case of retrofitting or upgrading an existing movement, the components already present, such as an escape wheel, anchor, and balance and hairspring, and possibly an anchor and/or pallet bridge (providing the upper bearing of the anchor), are removed and replaced with the reduction gear, the oscillator and optionally the anchor and/or adaptor according to present invention.

[0012] An example of a result the method according to the present invention is an existing and/or mainstream base plate or base plate design - that has already been used, e.g. is on the market, in e.g. 3 Hz (21,600 bph) or 4 Hz (28,800 bph) movements - with no post-machining or little post-machining, such as one or more added holes, threads, and/or pillars, and at least the higher frequency, optionally higher efficiency, oscillator and reduction gear installed.

[0013] The invention also relates to a kit for assembling a movement for a watch, in particular a wristwatch, which movement comprises a base plate that defines positions, typically circle cylindrical recesses and/or bearings, in particular jewels (rubies), for accommodating a mainspring, typically a so-called barrel containing a spiral

spring and having a geared circumference, a gear train, typically including the so-called center wheel and center pinion, third wheel and pinion, and fourth wheel and fourth pinion, an escape wheel, also known as escapement wheel, an anchor, often a so-called Swiss anchor), and an oscillator. The kit according to the present invention comprises:

- an oscillator, preferably having a natural frequency of 8 Hertz (Hz) or higher, and
- a reduction gear, preferably a wheel and pinion preferably on the same axis, to reduce torque and increase speed between the mainspring and the escape wheel (relative to the originally intended configuration), preferably between the gear train, in particular the fourth or seconds wheel, and the escape wheel and/or at least partially at the position for an escape wheel.

[0014] In an embodiment, the escape wheel in the kit has an outer diameter in a range from 1,5 to 5 mm, preferably in a range 2 to 4 mm, and/or is intended for a torque in a range from 10 to 500 nanoNewtonmeter (nNm), preferably in a range from 25 to 150 nNm.

[0015] In an embodiment, the kit comprises a bridge for securing the oscillator, and optionally also the escape wheel and/or an anchor, in the base plate, e.g. rotationally between the base plate and a bridge, typically in a (lower) jewel in the base plate and a(n upper) jewel in the bridge.

[0016] An embodiment of the kit comprises an adaptor to be secured in and/or on the base plate and having features for securing at least the base plate side of the oscillator and optionally of an anchor in place in and/or on the adaptor.

[0017] In an embodiment, the reduction comprises a co-axial wheel and pinion and/or has a reduction ratio in a range from 1,5 to 150, preferably in a range from 3 to 80, preferably in a range from 3,75 to 33,3, preferably in a range from 7,5 to 23,3.

[0018] In another embodiment, the mainspring has, in the unwound state, more than 10 windings, preferably more than 12 windings, preferably from 14 to 25 windings, e.g. to match the oscillator torque and/or to further increase runtime).

[0019] In an embodiment, the movement, in particular the base plate, originally had and/or was originally designed to have an oscillator having a natural frequency in a range from 2.5 to 5 Hz, e.g. 3 Hz (21,600 bph) or 4 Hz (28,800 bph) .

[0020] In an embodiment, the oscillator comprises and oscillator mass suspended from a ground by means of flexures and the ground is fastened, e.g. screwed or clamped, to the base plate, directly or indirectly, e.g. via the adaptor. In another embodiment, with the reduction installed, the escape wheel has a torque of less than 800 nanoNewtonmeter (nNm), preferably less than 600 nNm, preferably less than 300 nNm, preferably less than 200 nNm, preferably less than 150 nNm.

[0021] In other embodiments, the oscillator has and/or the anchor teeth have an amplitude in a range from 0,1° to 50° (to both sides, i.e. with an amplitude of e.g. 3° the oscillations span 6°), preferably smaller than 30°, preferably smaller than 20°, preferably smaller than 15°, e.g. in range from 3° to 10°, and/or the oscillator has a natural frequency of 10 Hz or higher, preferably 25 Hz or higher, preferably 30 Hz or higher, preferably in a range from 10 to 400 Hz, preferably in a range from 30 to 70 Hz.

[0022] In an example, the oscillator has a frequency of 40 Hz and an amplitude of 6°. In another example, the oscillator has a frequency of 400 Hz oscillator and an amplitude of 0,1°.

[0023] In an embodiment, at least the oscillator, anchor teeth, and escape wheel, and optionally the reduction gear, are configured as a single axis or multi-axes tourbillon, e.g. are mounted in a tourbillon cage. In an embodiment, the tourbillon cage rotates through 360 degrees, completing one full rotation once every 60 seconds.

[0024] In an embodiment, the reduction wheel, the escape wheel, and/or the oscillator is shaped by means of etching, such as reactive ion etching or deep reactive ion etching, lithography, electroplating, molding, or laser cutting and/or is made from silicon or metal. The component, such as an geared wheel, escape wheel, anchor, or oscillator may have a thickness smaller than 700 um, preferably smaller than 550 pm, preferably in a range from 50 um to 500 pm, preferably in a range from 100 μm to 300 μm.

[0025] It is preferred that at least the oscillator comprises an oscillating mass and flexures suspending the mass from a ground or frame, and optionally anchor teeth on/in the mass and/or flexures, and that the mass and flexures and preferably also the ground and/or anchor teeth are monolithic, i.e. made from a single piece, and/or form a compliant mechanism.

[0026] The invention also relates to a wristwatch comprising a movement obtained by means of the method or kit described above.

[0027] Within the framework of the present invention, the word "bridge" refers to components that are mounted (directly or indirectly) to the base plate on one more sides to secure watch components, such as the main spring, wheels, anchor, and balance, in place. Bridges typically have one or more bearings, e.g. jewels, to hold an end of a shaft of the component, while other end of the shaft is held by a (counter)bearing in the base plate. Thus, the term bridge included bridges that are secures or supported on only one side (point; cantilevered), which type of bridges is also referred to as cock.

Figure 1 is a perspective view of an existing base plate for a movement for a wristwatch.

Figure 2 is an enlarged view of part of the base plate shown in Figure 1 with the an adaptor according to the present invention installed.

Figure 3 is a top plan view of an oscillator, escape wheel and reduction wheel according to the present

invention.

Figure 4 is a top plan view of a bridge that secures in place the components of Figure 3.

Figure 5 is a top plan view of a movement obtained with the present invention.

[0028] Figure 1 shows a base plate 1 of a movement for a particular a wristwatch, that defines positions for the mainspring, drive train, escapement and balance. More specifically, it comprises a first (circle) cylindrical recess 2' and bearing 2" for the barrelled mainspring 2, which mainspring is shown in Figure 5, a second recess 3' for the so-called center wheel 3 (Figure 5), a third 4' recess for the (shaft of the) third wheel 4, a fourth bearing 5" for the fourth wheel 5, a fifth recess 6' and opening 6" for receiving a bearing for an escape wheel, an opening 7 for receiving a bearing for an anchor, and a sixth recess 8' for a balance and balance shaft and, in this recess 8', an opening 8" for receiving a shock protection system, such as Incabloc or Kif, and two threaded holes 8" ' on either side of the opening 8" for a shock protection system.

[0029] Figure 2 shows an enlarged view of part of the base plate shown in Figure 1 with an adaptor 9 installed in the sixth recess 8' for a balance and balance shaft. In this example, the adaptor is screwed to one of the threaded holes 9 on either side of the opening 8" for a shock protection system and it is provided with an alignment pin 10 and threaded hole 11 for attaching a bridge, as will be explained in more detail below. In the example, the adaptor also comprises a feature, such as a triangular protrusion 12, for clampingly attaching a monolithic oscillator, which, in that case, has at least one fixed reference point and at least one resilient element to urge a mounting part of the oscillator on-to the at least one reference point.

[0030] Figures 3 and 4 show a monolithic oscillator 20 comprising a substantially disc-shaped mass 21 that comprises two halves 21A, 21B that are compliantly interconnected by a set of flexures 22. Each of the halves is connected to a ground 23, having e.g. two openings 23A for screws or the like, by means of a plurality of further flexures, i.c. two radially extending flexures 24, four flexures in total, enabling the mass to oscillate. In the present example, the oscillator has a natural frequency in a range from 20 to 100 Hz, e.g. 40 Hz, and an amplitude in a range from 3° to 10° (in each direction, i.e. both in the CW direction and in the CCW direction), e.g. 5°.

[0031] Each of the halves 21A, 21B is provided with an anchor tooth 25, traditionally known as pallet. In this example, the anchor teeth are integrated in two of the flexures. Further, the halves define an aperture that accommodates an escapement wheel 26 comprising a plurality of teeth. During oscillation, the anchor teeth on the oscillator alternately block and release the teeth of the escape wheel 26.

[0032] The mass 21, flexures 22, 24, ground 23, and anchor teeth 25 are monolithic and a form a compliant mechanism. In this example, the mechanism 20 is made from a silicon wafer by means of DRIE.

[0033] In Figures 4 and 5, the oscillator 2 and escape wheel 26 have been attached to the base plate by means of a bridge 30 and screws 31 and an upper escape wheel bearing 32. A reduction gear 6 has been provided between the fourth wheel 5 and the escape wheel 26 to provide a reduction of e.g. 9. The oscillator, escape wheel, bridge, and reduction gear were provided as a kit to provide an upgraded movement 35.

[0034] The invention is not limited to the described embodiments and can be varied within the scope of the claims. For instance, at least the oscillator, anchor teeth, and escape wheel, and optionally the reduction gear, can be configured as a tourbillon, e.g. mounted in a tourbillon cage, which rotates through 360 degrees, completing one full rotation once every 60 seconds.

Claims

1. Method of assembling a movement (35) for a watch, in particular a wristwatch, which method comprises the steps of:

   - providing a base plate (1) that defines positions for accommodating a mainspring (2), a gear train (3-5), an escape wheel, an anchor, and an oscillator, **characterized by**
   - mounting an oscillator (20) having a natural frequency of at least 8 Hz in and/or on the base plate (1), and
   - mounting at least one reduction gear (6) between the mainspring and the escape wheel (26).

2. Method according to claim 1, comprising

   - placing the at least one reduction wheel (6) and pinion at least partially at the position (6") for an escape wheel,
   - placing an escape wheel (26) in the base plate (1), and/or
   - securing the escape wheel (26), and preferably also the oscillator (20), operatively in place by means of a bridge (30) over the escape wheel (26) and optionally over the oscillator (20).

3. Method according to claim 1 or 2, wherein the base plate (1) defines a position (7) for an anchor and comprising the step of placing the escape wheel (26) at least partially in that position (7).

4. Method according to any one of the preceding claims, comprising the step of mounting an adaptor (9) in and/or on the base plate (1) and securing at least the base plate side of the oscillator (20), and optionally of anchor teeth (25), the reduction gear (6), and/or the escape wheel in and/or on the adaptor

(9).

5. Method according to any one of the preceding claims, comprising clamping the oscillator (20) to the base plate (1) or to the adaptor (9).

6. Kit for assembling a movement for a watch, in particular a wristwatch, which movement comprises a base plate (1) that defines positions (3'-6') for accommodating a mainspring (2), a gear train (3-5), an escape wheel, an anchor, and an oscillator, the kit comprising:

- an oscillator (20), preferably having a natural frequency of 8 Hertz (Hz) or higher, and
- a reduction gear (6) to reduce torque and increase speed between the mainspring (2) and the oscillator (20), preferably between the gear train (3-5) and the escape wheel (26) and/or at least partially at the position for an escape wheel (6').

7. Kit according to claim 6, comprising

- an escape wheel (26), preferably having an outer diameter in a range from 1,5 to 5 mm, preferably 2 to 4 mm. and/or intended for a torque in a range from 10 to 500 nanoNewtonmeter (nNm), preferably in a range from 25 to 150 nNm, and

8. Kit according to claim 6 or 7, comprising a bridge (30) for operatively securing the escape wheel (26) and optionally the oscillator (20) in the base plate (1).

9. Kit according to any one of claims 6-8, comprising an adaptor (9) to be secured in and/or on the base plate (1) and having features for securing at least the base plate side of the oscillator (20) and optionally of an anchor (25) in place in and/or on the adaptor (9).

10. Method or kit according to any one of the preceding claims, wherein the reduction gear (6) comprises a co-axial wheel and pinion and/or has a reduction ratio in a range from 1,5 to 150, preferably in a range from 3 to 80, preferably in a range from 3,75 to 33,3, preferably in a range from 7,5 to 23,3, and/or comprising a mainspring (2) having, in the unwound state in the barrel, more than 7 windings, preferably more than 10 windings, preferably more than 12 windings, preferably in a range from 14 to 25 windings.

11. Method or kit according to any one of the preceding claims, wherein the movement, in particular the base plate, originally had and/or was originally designed to have an oscillator having a natural frequency in a range from 2.5 to 5 Hz, e.g. 3 Hz (21,600 bph) or 4 Hz (28,800 bph).

12. Method or kit according to any one of the preceding claims, wherein, with the reduction gear (6) installed, the escape wheel (26) has a torque of less than 800 nanoNewtonmeter (nNm), preferably less than 600 nNm, preferably less than 300 nNm, preferably less than 200 nNm, preferably less than 150 nNm.

13. Method or kit according to any one of the preceding claims, wherein the oscillator (20) has and/or the anchor teeth have an amplitude in a range from 0,1° to 50° preferably smaller than 30°, preferably smaller than 20°, preferably smaller than 15°, e.g. in range from 3° to 10°, and/or the oscillator has a natural frequency of 8 Hertz (Hz) or higher, preferably 10 Hz or higher, preferably 25 Hz or higher, preferably 30 Hz or higher, preferably in a range from 10 to 400 Hz, preferably in a range from 30 to 70 Hz.

14. Method or kit according to any one of the preceding claims, wherein at least the oscillator (20), anchor teeth (25), and escape wheel (26), and optionally the reduction gear (6), are configured as a tourbillon.

15. Wristwatch comprising a movement (35) obtained by means of the method or kit according to any one of the preceding claims.

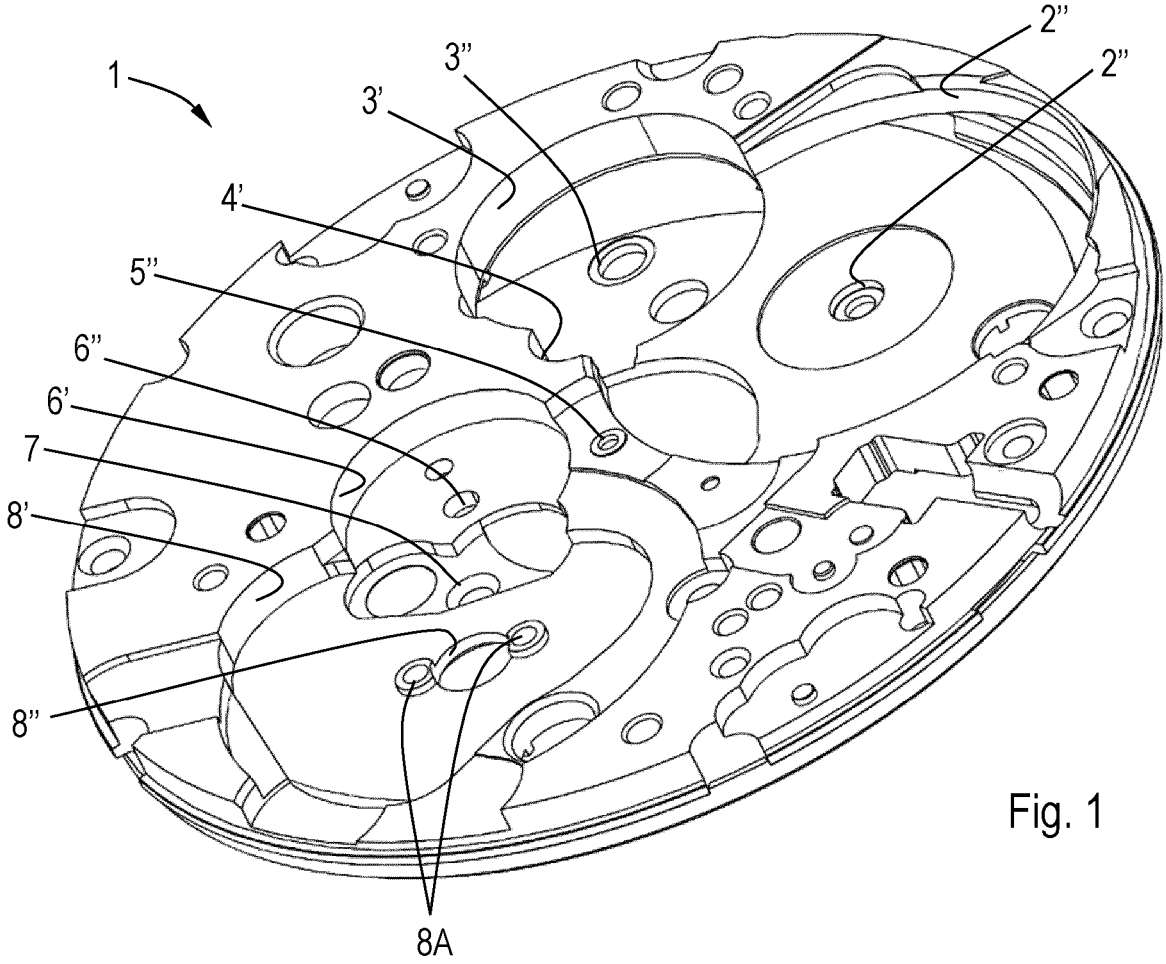

Fig. 1

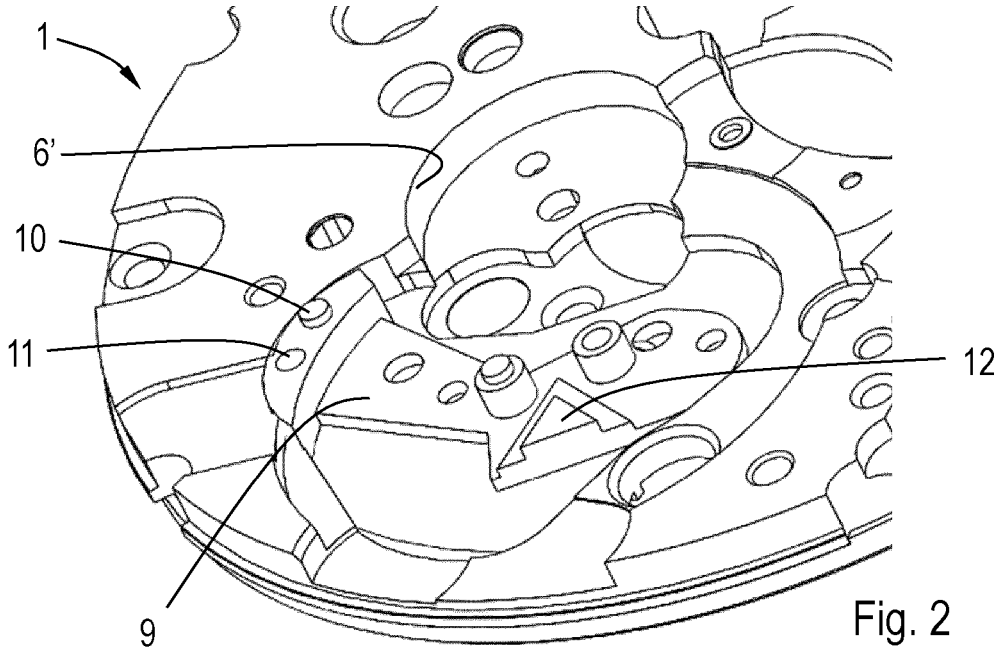

Fig. 2

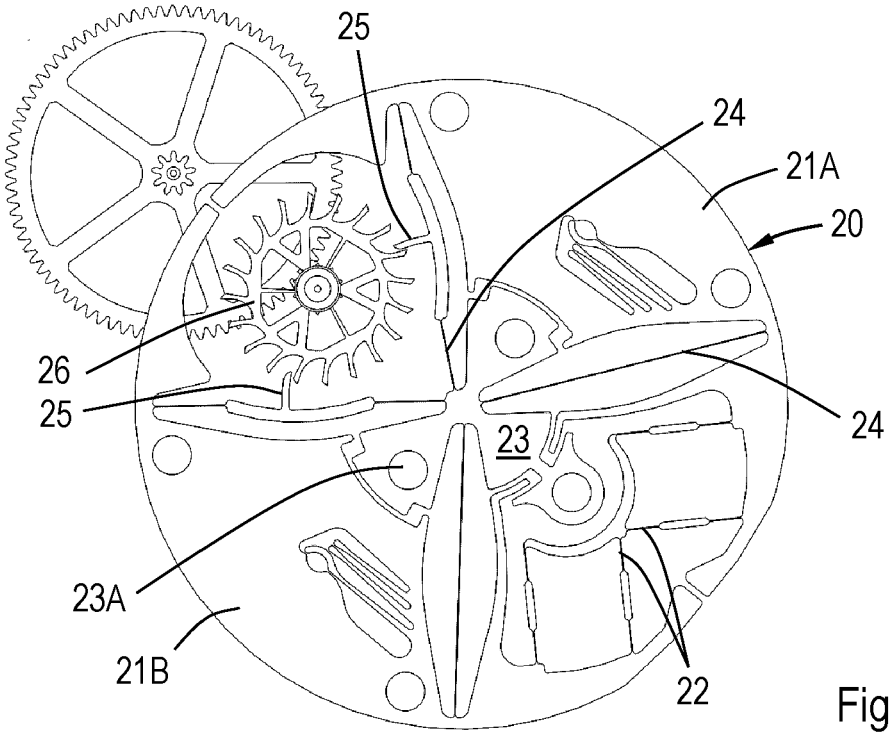

Fig. 3

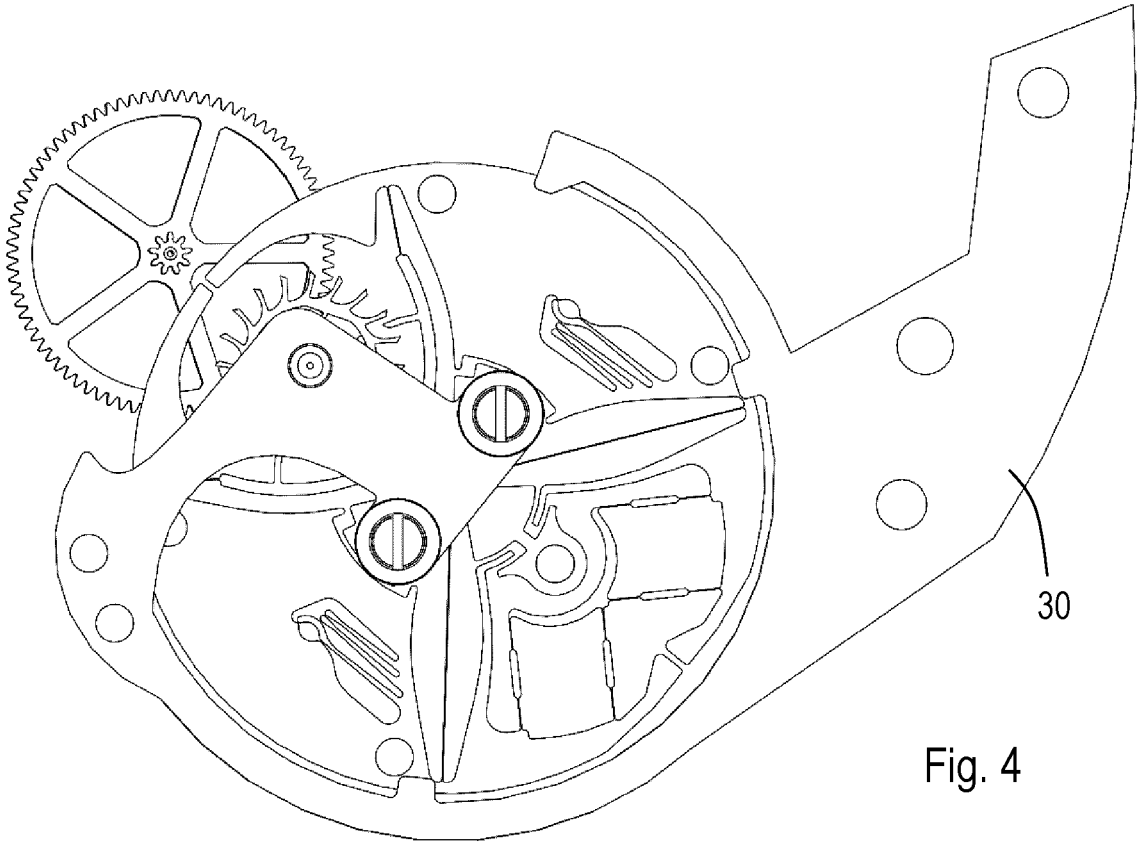

Fig. 4

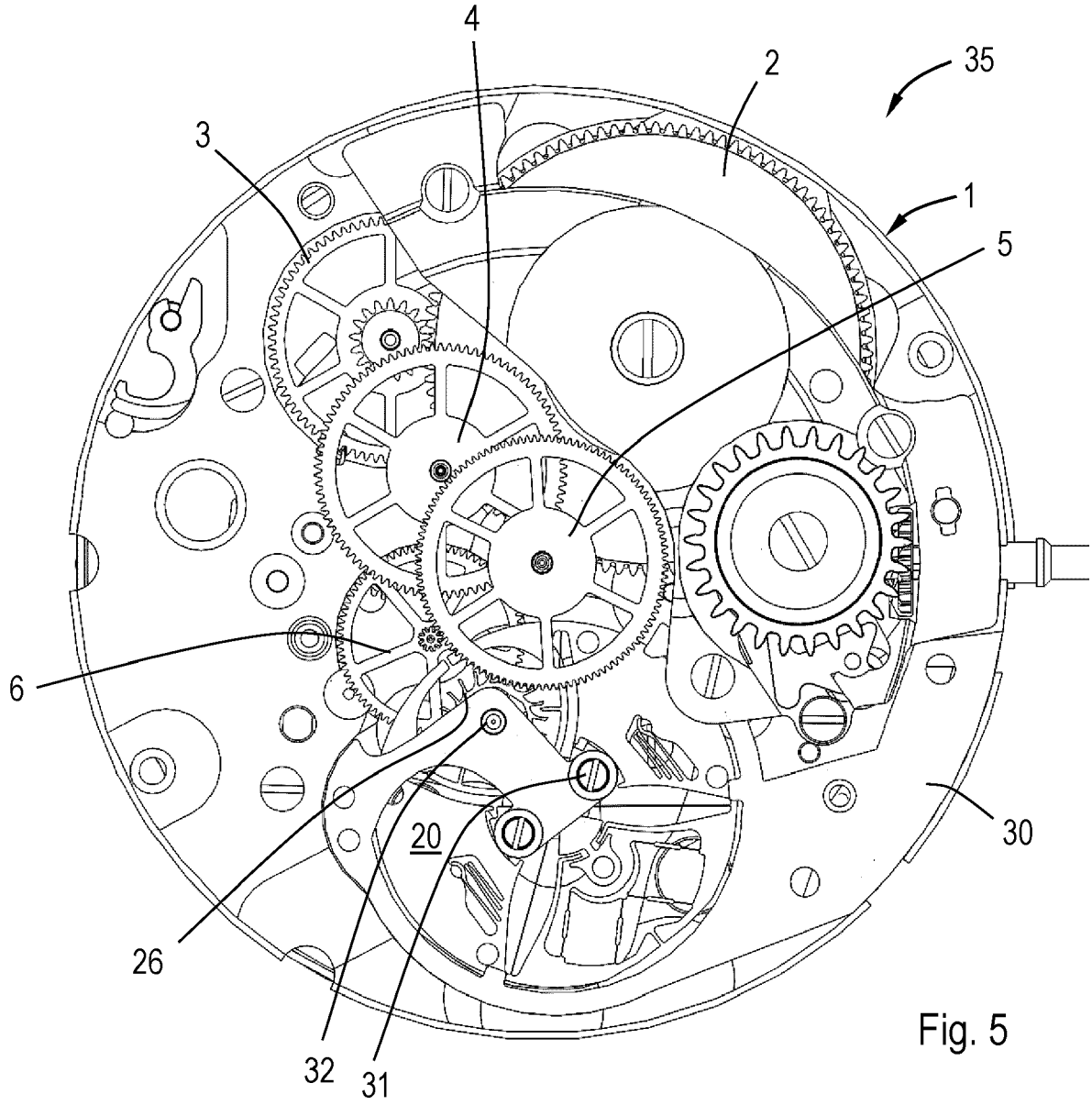

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 5665

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 December 2023	Cavallin, Alberto

CATEGORY OF CITED DOCUMENTS

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