(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 August 2017 (24.08.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/141101 A1

(51) International Patent Classification:
G04B 1/22 (2006.01)

(21) International Application Number:
PCT/IB2017/000115

(22) International Filing Date:
15 February 2017 (15.02.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/295,216 15 February 2016 (15.02.2016) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: CADENCE DEVICE

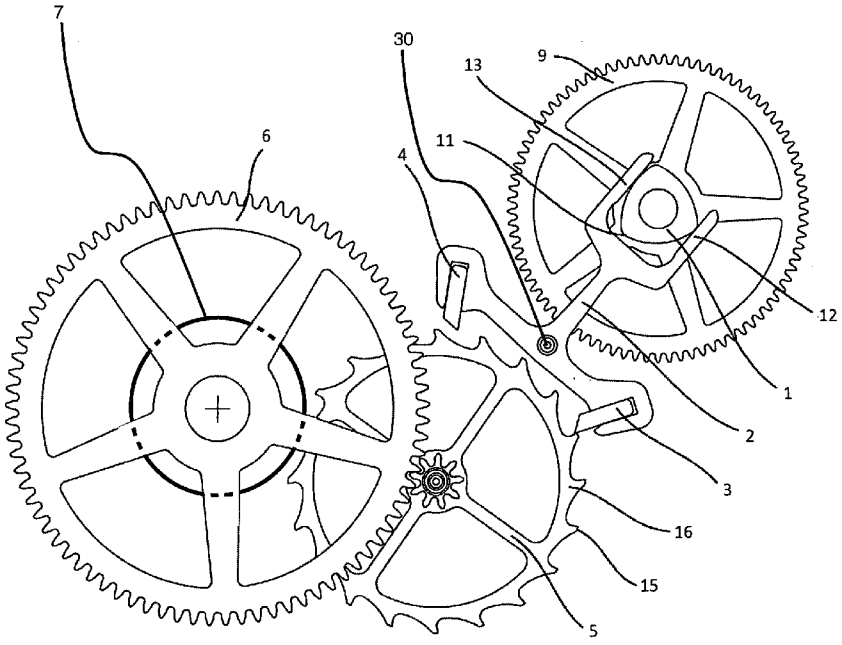


FIG. 1

[Continued on next page]

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(57) Abstract: A cadence device is provided including a system with main energy source (10), main gear (9) and main regulating device mechanism (8). The mechanism includes a cam (1), secured directly or through one or more auxiliary gear(s) (17, 17') to the main transmission gear (9) and works with a regulation pallet fork (2) periodically releasing the regulation wheel (5), driven by a secondary energy source (7), through a secondary transmission gear (6).

CADENCE DEVICE

Cross Reference to Related Applications

This application claims the benefit of U.S. Provisional Application US 62/295,216, filed 15 February 2017, entitled: CADENCE DEVICE.

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Background of the Invention

This invention relates to an improvement to a drive mechanism in a watch movement.

Prior art devices typically use a single energy source and a gear train that drives both the regulating device and additional mechanisms. However, this double duty results in a degradation in accuracy.

Watch movements with multiple energy requirements are well known and suffer from the problem of synchronizing the motion of the gear train(s) that drives additional mechanisms with the gear train(s) that drives the regulating device and that counts oscillations.

What is needed therefore is a means of separating the energy needs of ancillary devices such as a chronometer or a moon phase indication, from the energy source which powers the time regulation of the time piece. In other words, what is needed is a device which provides a new way to connect the gear train used to drive ancillary mechanisms and the gear train used to drive the regulator or oscillating and counting device, in order to be able to drive energy demanding mechanisms without significant influence on the regulating device thereby improving accuracy of the timepiece.

Summary of the Invention

This invention relates to an improvement to drive mechanisms in a watch movement. Instead of using a single energy source and gear train that drive both the regulating device and additional mechanisms, the invention uses a separate energy source and gear train for each. Although watch movements with multiple energy sources are well known, they suffer from the difficulty of synchronizing the motion of the gear train that drives additional mechanisms with the gear train that drives the regulating device and counts oscillations.

The watch movement of the invention includes one energy source which supplies the isochronal oscillating system (the regulator), using a transmission gear.

The movement includes one other energy source, supplying energy to additional mechanisms, or to a display mechanism of hours and minutes, by a transmission which is composed of a wheel referred to as the "regulation wheel", of which one tooth is in contact with the pallet fork, called the regulation pallet fork, which locks the wheel against rotation.

A cam is linked to a gear of a primary gear train which connects a primary energy source to the regulating device mechanism, either directly integrally, for example, via one of the gears of this gear train or alternatively by the intermediary of an auxiliary gear. The cam is secured on one of the mobiles of this gear, or could also be secured on an auxiliary gear. The cam drives the regulation pallet fork and provides its periodic motion. This cam and the regulating pallet fork could be of various shapes based on the period of the pallet fork per cam rotation and the amplitude of the movement of the pallet fork needed for a particular application.

In its periodic motion, the regulation pallet fork frees the regulation wheel and allows a half-tooth to escape. In other words, the regulation wheel rotates until the pallet fork locks on a tooth. The number of teeth of the regulation wheel number may be from one to any number.

The system made up of the regulation pallet fork and regulation wheel permits the freeing, via periodic impulses, of the secondary gear dedicated to supply energy to complications, driven by a secondary energy source, synchronized with the main oscillating and isochronal system energized by the primary energy source, without influencing its chronometric performance.

An object of the invention is to solve the particular problem of synchronizing watch movement and ancillary time keeping mechanisms.

Another object of the invention is to provide a new way to connect the gear train used to drive particular mechanisms and the gear train used to drive the regulating device, to be able to

drive energy demanding mechanisms without significant influence on the regulation of the time piece.

Brief Description of the Drawings

FIG. 1 is a plan view of the first phase of lock and approach.

FIG. 2 is a plan view of the second phases of jump and approach.

FIG. 3 is a plan view of the third phases of lock and exit.

FIG. 4 is a plan view of the fourth phases of jump and exit.

FIG. 5 is a schematic view of the different functional components of the cadence device.

FIG. 6 is a plan view of one variant of the cam of the invention.

FIG. 7 is a plan view of a second variant of the cam of the invention.

FIG. 8 is a plan view of a third variant of the cam of the invention.

FIG. 9 is a plan view of a fourth variant of the cam of the invention.

FIG. 10 is a plane view of an alternate embodiment of the invention, using two cams.

FIG. 11 is a plan view of a second alternate embodiment having one cam and one follower.

FIG. 12 is a plan view of a third alternate embodiment in which the main transmission gear is indirectly connected to the cam.

Those skilled in the art will appreciate that elements in the Figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, dimensions may be exaggerated relative to other elements to help improve understanding of the invention and its embodiments. Furthermore, when the terms `first`, `second`, and the like are used herein, their use is intended for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. Moreover, relative terms like `front`, `back`, `top` and `bottom`, and the like in the Description and/or in the claims are not necessarily used for describing exclusive relative position. Those skilled in the art will therefore understand that such terms may be interchangeable with other terms, and that the embodiments described herein are capable of operating in other orientations than those explicitly illustrated or otherwise described.

Detailed Description of the Preferred Embodiment

The following description is not intended to limit the scope of the invention in any way as they are exemplary in nature, serving to describe the best mode of the invention known the inventors as of the filing date hereof. Consequently, changes may be made in the arrangement and/or function of any of the elements described in the exemplary embodiments disclosed herein without departing from the spirit and scope of the invention.

Referring now to **FIG. 1**, phase 1 : lock-approach, the cam 1 turns in counterclockwise direction in the instant illustration and pushes a follower 12 and consequently guides the pallet fork 2 in an approach position where the pallet 3 is in contact with a tooth of the regulation wheel 5. The regulation wheel 5 features one or more teeth 15. The teeth 15 might be positioned at the exterior or interior of the rim 16. The instant illustration shows the teeths 15 at the exterior of the rim 16. The regulation wheel 5, even though driven by the secondary gear train 6, remains stationary by virtue of its contact with the approaching pallet 3. This phase lasts sufficiently long for the angular position of the cam 1 to give to the pallet fork 2 a position which permits maintaining the contact between the approaching pallet 3 and the regulation wheel 5.

Referring now to **FIG. 2**, illustrating phase 2 : jump-approach, at the end of phase 1, the cam 1 turns in a counterclockwise direction in the instant illustration and pushes a follower 13 and consequently guides the pallet fork 2 around its pivot point 30 such that contact flanks 1a between the approach pallet 3 and the regulation wheel 5 is lost. The regulation wheel 5 is now free and begins its movement (in a counterclockwise direction in the instant illustration), driven by the secondary drive train 6. This phase 2 ends when a tooth of the regulation wheel 5 enters into contact with the exit pallet 4 of the pallet fork 2.

Note that the contact surface of the follower 12, 13 can be straight, convex or concave to correspondent with the form of the fanks 1a, 1a', 1a'', 1a''' of the cam(s) 1.

Referring now to **FIG. 3**, phase 3 : lock-exit, at the end of phase 2, one of the teeth of the regulation wheel 5 contacts the exit pallet 4 of the pallet fork 2. In phase 3, the regulation wheel 5 remains essentially stationary by this contact, while the angular positions of the cam 1 during further turning in the counterclockwise direction in the instant illustration, which guides the pallet fork 2 through the followers 12, 13, which permits the maintenance of this contact.

Referring now to **FIG. 4**, phase 4 : jump-exit, at the end of phase 3, contact between the regulation wheel 5 and the exit pallet 4 is lost, as the cam 1 further turns in a counterclockwise

direction in the instant illustration and thereby pushes the follower 12 and consequently guides the pallet fork 2 around its pivot point 30. The regulation wheel 5 is now free and begins movement in the counterclockwise direction in the instant illustration, driven by the secondary gear train 6. Phase 4 ends and phase 1 succeeds this phase while a tooth of the regulation wheel 5 enters into contact with the approaching pallet 3 of the pallet fork 2. Note that the cam 1 may have a circular flank and be mounted eccentrically as shown by the dashed lines

Referring now to **FIG. 5**, a simplified schematic of the elements of the invention, showing their interconnection, includes the cam 1, the regulation pallet fork 2, the regulation wheel 5, the secondary transmission gear 6, the secondary energy source 7, the main oscillating device mechanism 8, the main transmission gear 9, and the main energy source 10.

It should be noted that the oscillating mechanism 8 can optionally be made up of, at least in part, for example, an electric, electromagnetic, or compressed gas or fluid energy source (not shown). The oscillating mechanism may also be of the electronic, quartz type, without departing from the spirit and scope of the invention. The secondary energy source may also be a source other than a purely mechanical source, such as electric, electromagnetic, or compressed gas or fluid energy source.

Still further, although the typical application of the invention is for time pieces with complications, other fields of application such as medical (pace making), tracking cadences, such as sport or musical cadences, etc. are envisaged.

Referring now to **FIGs. 6** to **9,** the cam 1 may have sharp corners 11 or rounded corners 11'. The cadence device of claim 1, in which the cam (1) has an odd number of flanks 1a, 1a', 1a'', 1a'''. The cam 1 is optionally essentially polygonal in form and has concave, straight, convex or curved flanks 1a, 1a', 1a'', 1a''' whose centers are eccentric to the center of rotation of the cam. Note however that a circular cam that is eccentrically mounted could also be used.

Referring now to **FIG. 10**, an alternate embodiment of the invention, using two cams 1a and 1b and two followers 12 and 13 is shown. The cams 1c and 1d turn in a synchronized manner, in the same direction and at an identical angular speed. The cam 1c turns in a counterclockwise direction in the instant illustration and pushes a follower 13. The cam 1d turns in a counterclockwise direction in the instant illustration and pushes a follower 12. The turning of the cams 1c and 1d allow operation according to the phases 1 to 4 as described in **FIGs.1** to **4**.

Referring now to **FIG. 11**, a second alternate embodiment has one cam 1 and one follower 13', which is held in contact with the cam 1 via an external device such as a spring 14. The cam 1 turns and pushes the follower 13' to a maximum deflection. The cam 1 turns further and the follower 13' is repeled by the device such as a spring 14. In addition as an option, in the instant illustration the axis of the cam 1, pallet fork 2 and regulation wheel 5 are not collinear.

Referring now to **FIG. 12**, a third alternate embodiment is shown in which the main transmission gear or gear train 9 is indirectly connected to the cam 1 through one or more auxiliary gear(s) 17, 17'.

In an advantage, the invention solves the particular problem of synchronizing cadence such in a watch movement and ancillary time keeping mechanisms.

In another advantage, the invention provides a novel means of connecting the gear train used to drive mechanisms and the gear train used to drive the regulating device, to be able to drive energy demanding mechanisms without significant influence on the regulation of the time piece.

Further, the invention should be considered as comprising all possible combinations of every feature described in the instant specification, appended claims, and/or drawing figures which may be considered new, inventive and industrially applicable.

It should be appreciated that the particular implementations shown and herein described are representative of the invention and its best mode and are not intended to limit the scope of the present invention in any way.

As will be appreciated by skilled artisans, the present invention may be embodied as a system, a device, or a method.

The present invention is described herein with reference to block diagrams, devices, components, and modules, according to various aspects of the invention.

Moreover, the system contemplates the use, sale and/or distribution of any goods, services or information having similar functionality described herein.

The specification and figures should be considered in an illustrative manner, rather than a restrictive one and all modifications described herein are intended to be included within the scope of the invention claimed. Accordingly, the scope of the invention should be determined by the appended claims (as they currently exist or as later amended or added, and their legal equivalents) rather than by merely the examples described above. Steps recited in any method or process claims, unless otherwise expressly stated, may be executed in any order and are not limited to the

specific order presented in any claim. Further, the elements and/or components recited in apparatus claims may be assembled or otherwise functionally configured in a variety of permutations to produce substantially the same result as the present invention. Consequently, the invention should not be interpreted as being limited to the specific configuration recited in the claims.

Benefits, other advantages and solutions mentioned herein are not to be construed as critical, required or essential features or components of any or all the claims.

As used herein, the terms "comprises", "comprising", or variations thereof, are intended to refer to a non-exclusive listing of elements, such that any apparatus, process, method, article, or composition of the invention that comprises a list of elements, that does not include only those elements recited, but may also include other elements described in the instant specification. Unless otherwise explicitly stated, the use of the term "consisting" or "consisting of" or "consisting essentially of" is not intended to limit the scope of the invention to the enumerated elements named thereafter, unless otherwise indicated. Other combinations and/or modifications of the above-described elements, materials or structures used in the practice of the present invention may be varied or adapted by the skilled artisan to other designs without departing from the general principles of the invention.

The patents and articles mentioned above are hereby incorporated by reference herein, unless otherwise noted, to the extent that the same are not inconsistent with this disclosure.

Other characteristics and modes of execution of the invention are described in the appended claims.

Further, the invention should be considered as comprising all possible combinations of every feature described in the instant specification, appended claims, and/or drawing figures which may be considered new, inventive and industrially applicable.

Additional features and functionality of the invention are described in the claims appended hereto. Such claims are hereby incorporated in their entirety by reference thereto in this specification and should be considered as part of the application as filed.

Multiple variations and modifications are possible in the embodiments of the invention described here. Although certain illustrative embodiments of the invention have been shown and described here, a wide range of changes, modifications, and substitutions is contemplated in the foregoing disclosure. While the above description contains many specific details, these should not

be construed as limitations on the scope of the invention, but rather exemplify one or another preferred embodiment thereof. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the foregoing description be construed broadly and understood as being illustrative only, the spirit and scope of the invention being limited only by the claims which ultimately issue in this application.

What is Claimed is:

1. Cadence device including a system with energy source (10), main transmission gear (9) and regulating device mechanism (8), characterized in that the system has at least one cam (1), secured to the main transmission gear (9), the cam interacting with a regulation pallet fork (2) to periodically release a regulation wheel (5) driven by a secondary energy source (7), through a secondary transmission gear (6).

2. The cadence device of claim 1, in which the cam (1) has an odd number of flanks (1a, 1a', 1a'', 1a''').

3. The cadence device of claim 1, in which the cam (1) is polygonal and has curved flanks (1a) whose centers are eccentric to the center of rotation of the cam.

4. The cadence device of claims 1 or 2, in which each flank (1a'') of the cam is straight.

5. The cadence device of claims 1 or 2, in which each flank (1a, 1a') of the cam (1, 1') is convex.

6. The cadence device of claims 1 or 2, in which each flank (1a''') of the cam (1''') is concave.

7. The cadence device of claim 1, in which the flank (1a'''') is circular and the cam is mounted eccentrically.

8. The cadence device of any one of claims 1-7, wherein the cam (1, 1', 1'', 1''') has at least one apex (11).

9. The cadence device of claim 8, wherein the at least one apex (11') is rounded.

10. The cadence device of claim 8, wherein the at least one apex (11, 11'', 11''') is pointed.

11. The cadence device of any one of claim 1-10, wherein the pallet fork (2) is shaped such that the pallet fork (2) is guided by the at least one cam (1, 1', 1'', 1''') in an oscillating motion in relation to its angular position.

12. The cadence device of any one of claims 1-10, wherein the pallet fork (2) is made up of at least two followers (12, 13) in contact with at least two cams (1c, 1d).

13. The cadence device of any one of claims 1-10, wherein the pallet fork (2) is made up of at least two followers (12, 13) in contact with two or more of parts of the same cam (1, 1', 1'', 1''').

14. The cadence device of any one of claims 2-10, wherein a follower (13') is maintained in contact with the cam (1, 1', 1'', 1''') by an external device such as a spring (14).

15. The cadence device of claim 1, wherein the regulation wheel (5) provides at least one tooth (15), at the interior or exterior of a rim (16).

16. The cadence device of claim 1, wherein the center of rotation of the cam (1, 1', 1'', 1'''), the pallet fork (2) and the regulation wheel (5) are collinear.

17. The cadence device of claim 1, wherein the center of rotation of the cam (1), the pallet fork (2) and the regulation wheel (5) are not collinear

18. The cadence device of claim 1, wherein the at least one cam (1, 1', 1'', 1''') is secured indirectly to the main transmission gear (9) through an auxiliary gear (16).

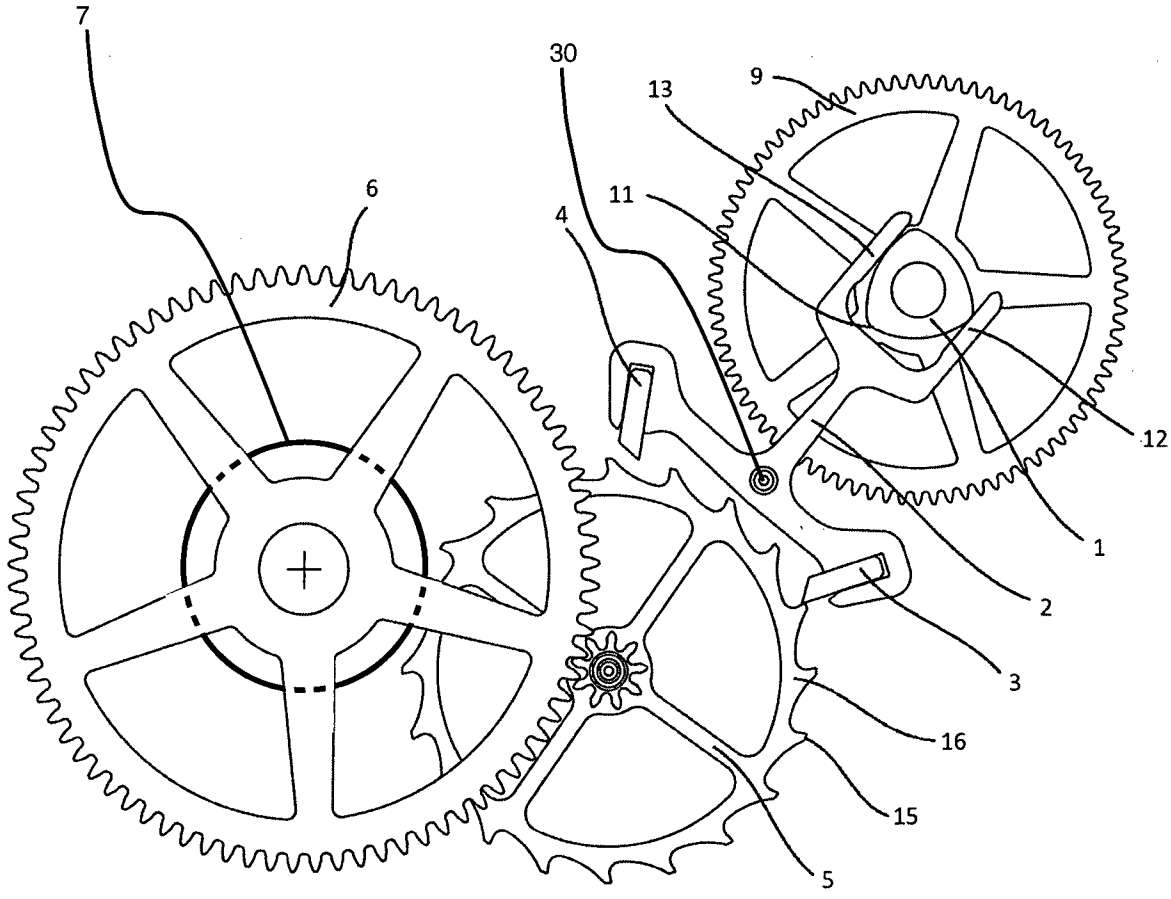


FIG. 1

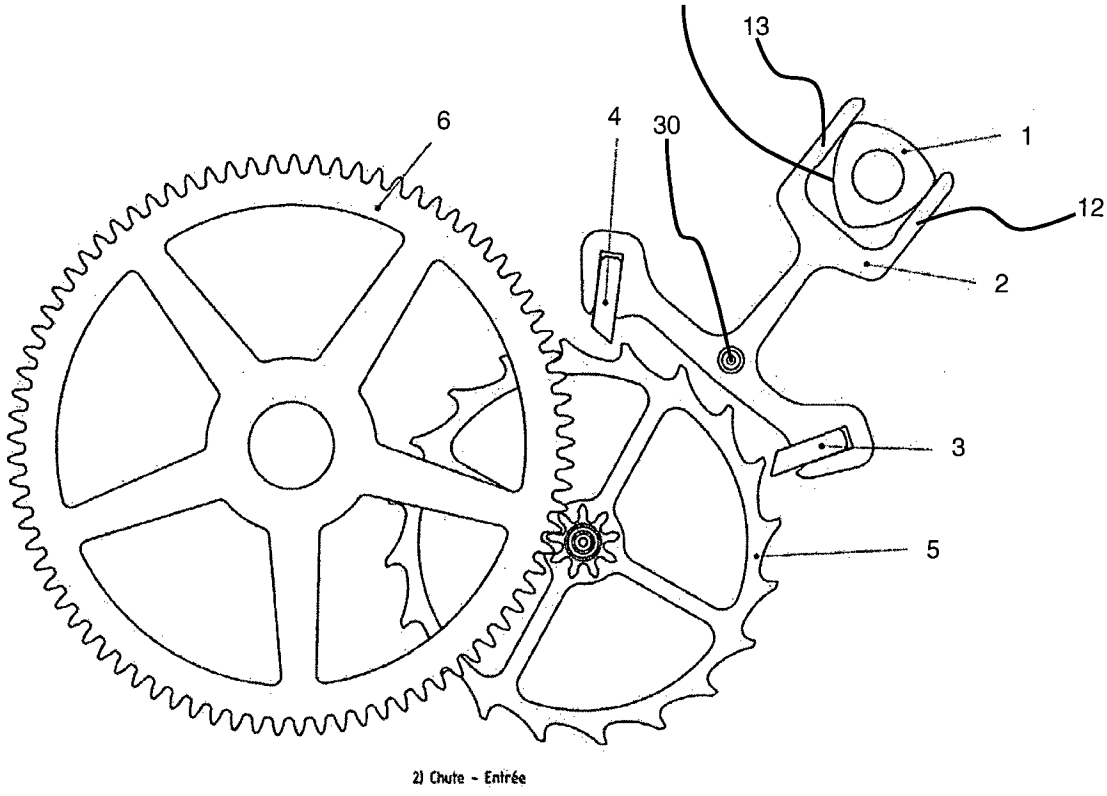


FIG. 2

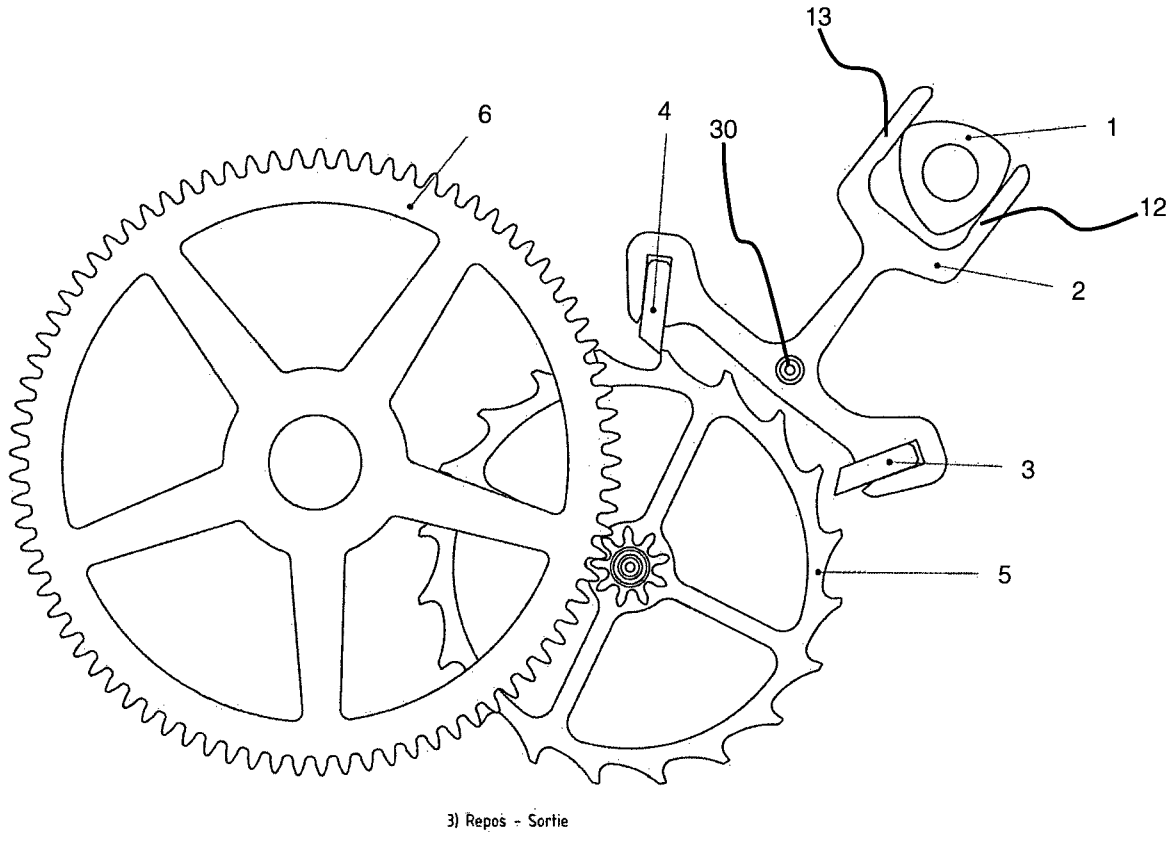


FIG. 3

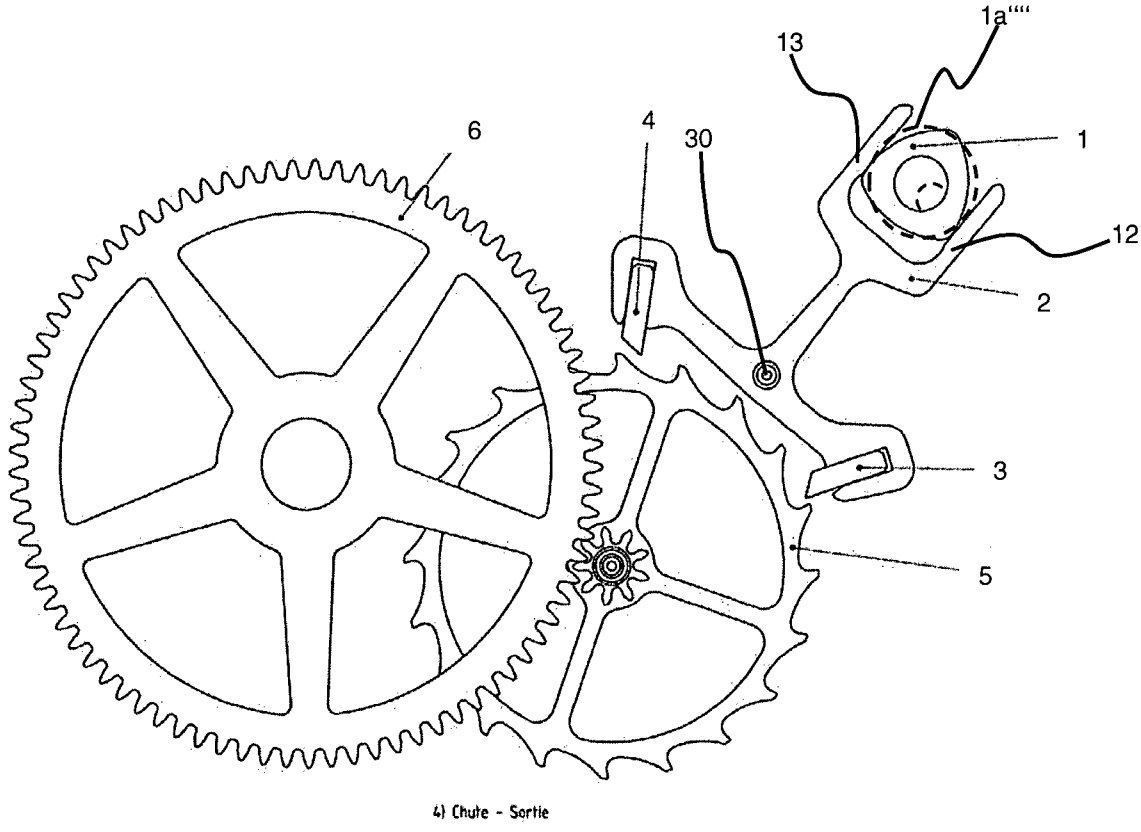


FIG. 4

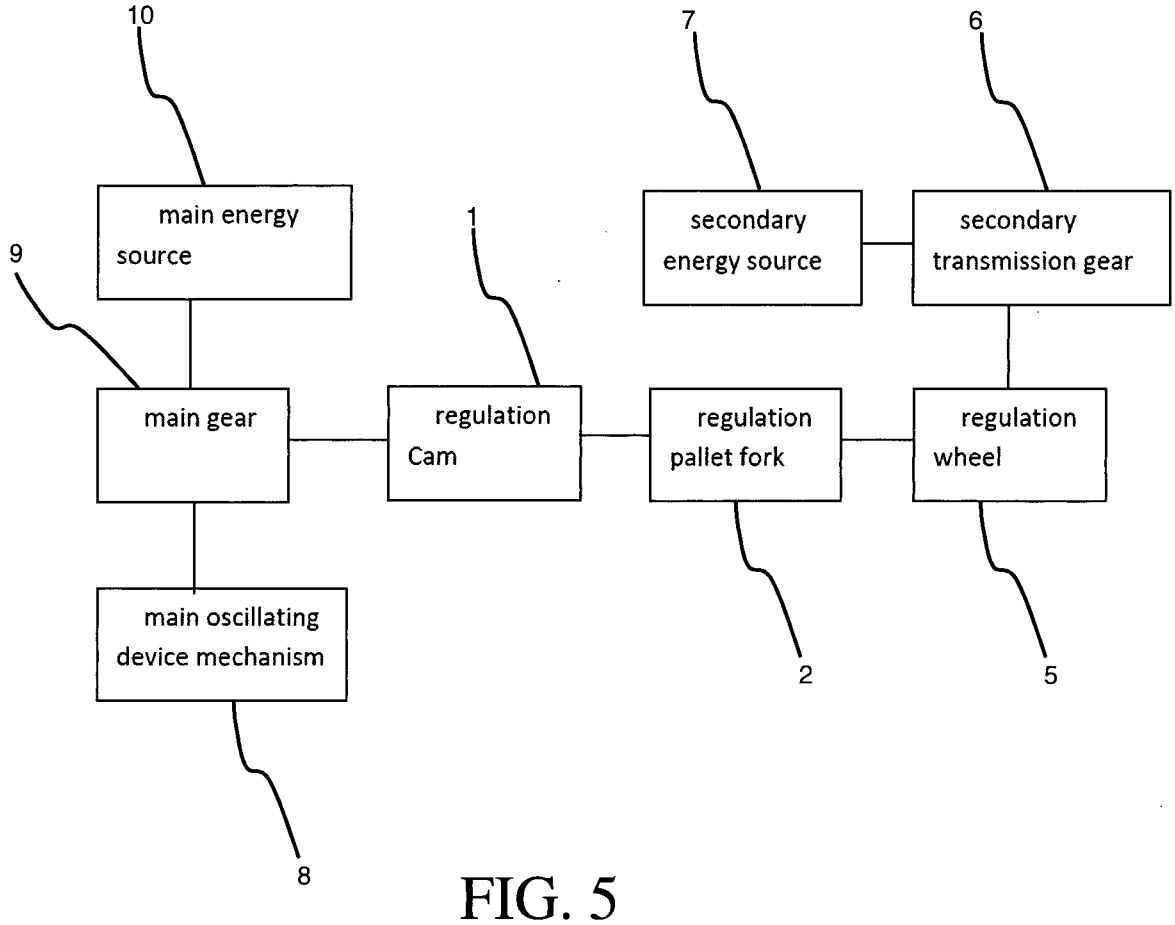

10
7
6
main energy source
secondary energy source
secondary transmission gear
9
1
main gear
regulation Cam
regulation pallet fork
regulation wheel
main oscillating device mechanism
2
5
8

FIG. 5

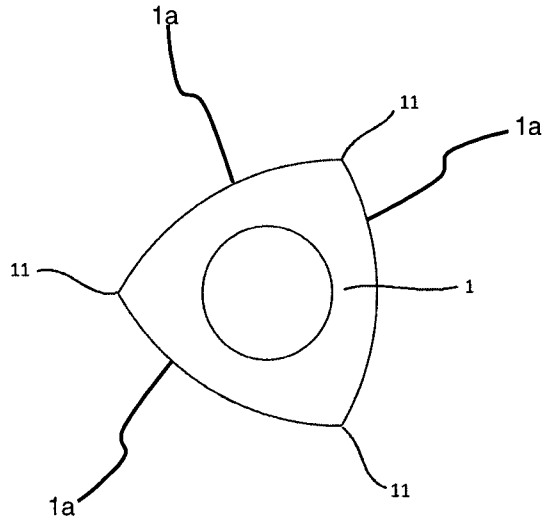


FIG. 6

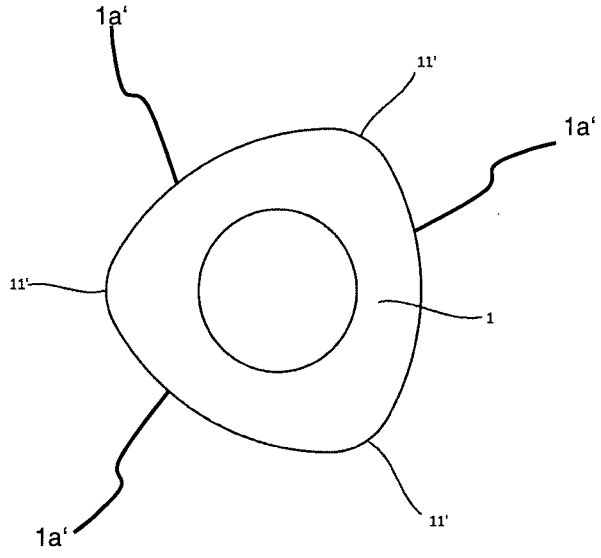


FIG. 7

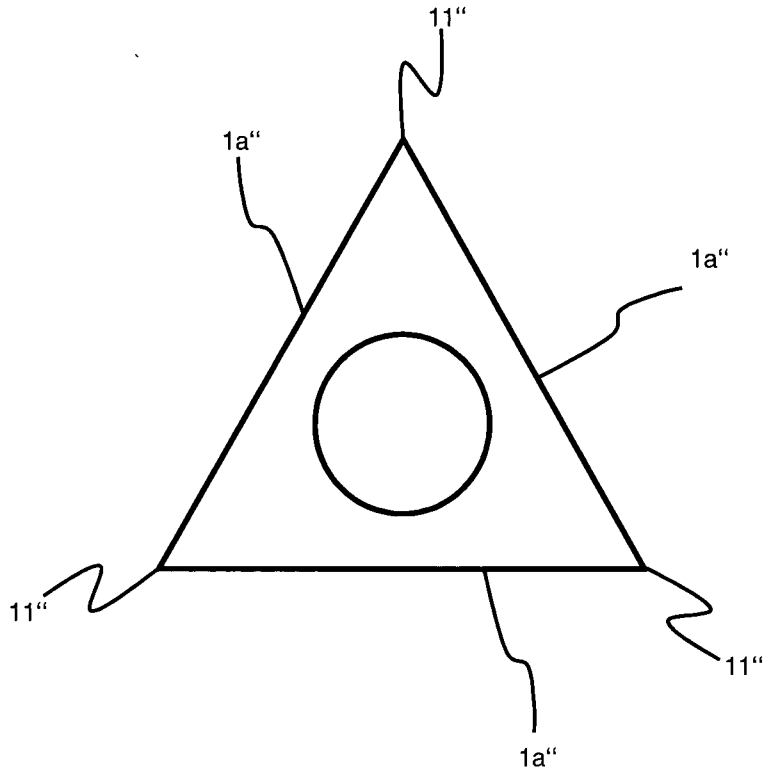


FIG. 8

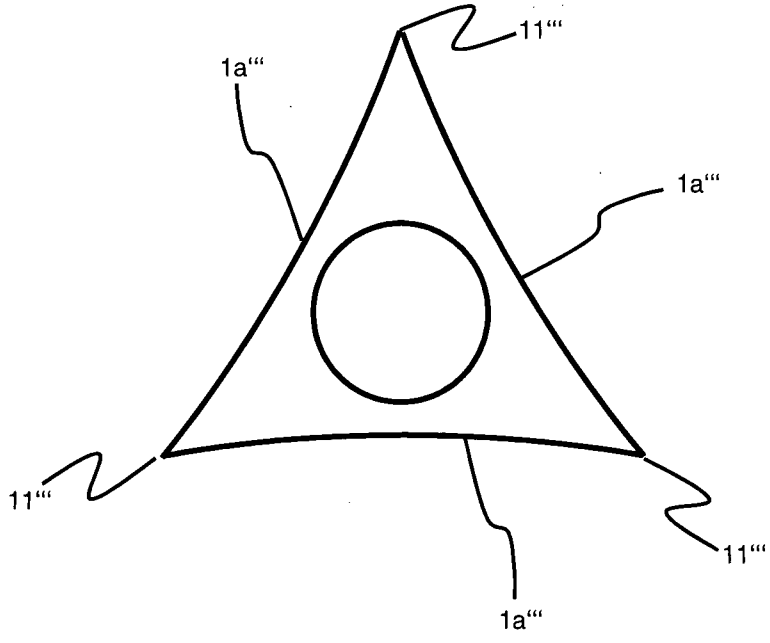


FIG. 9

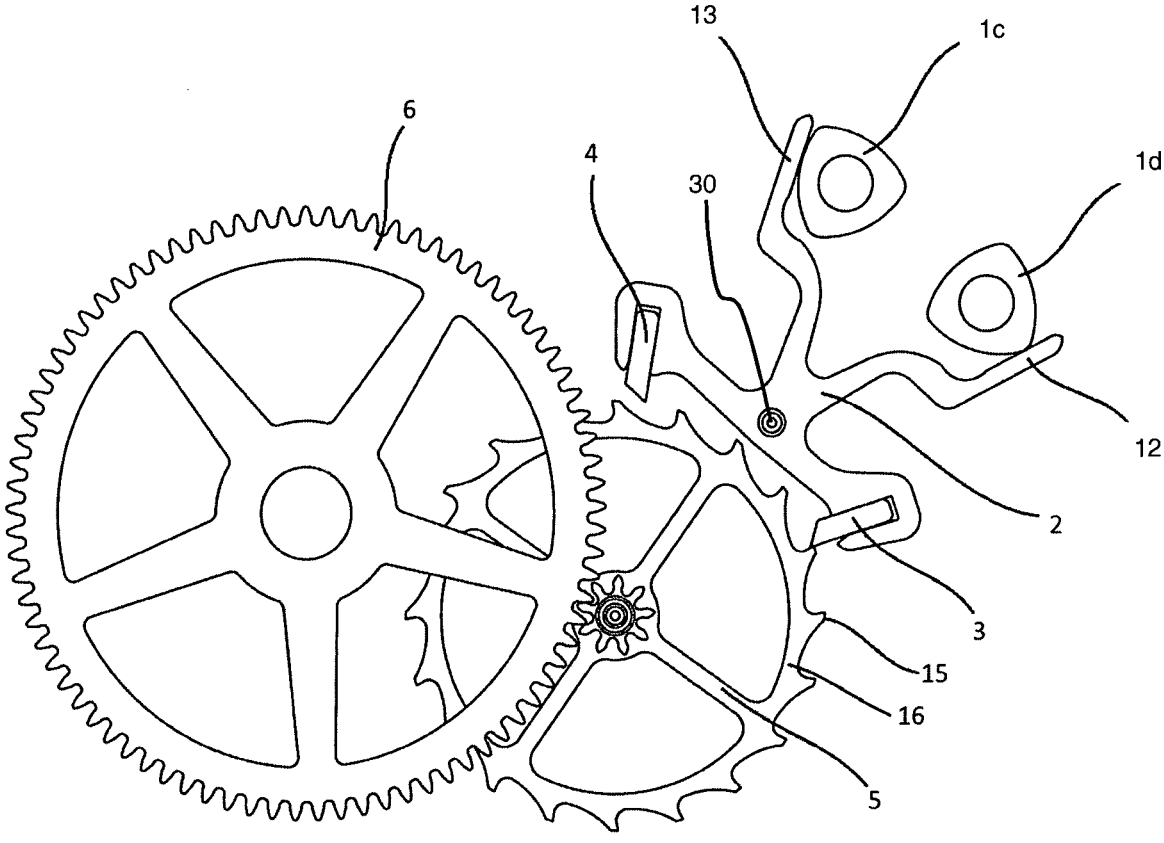


FIG. 10

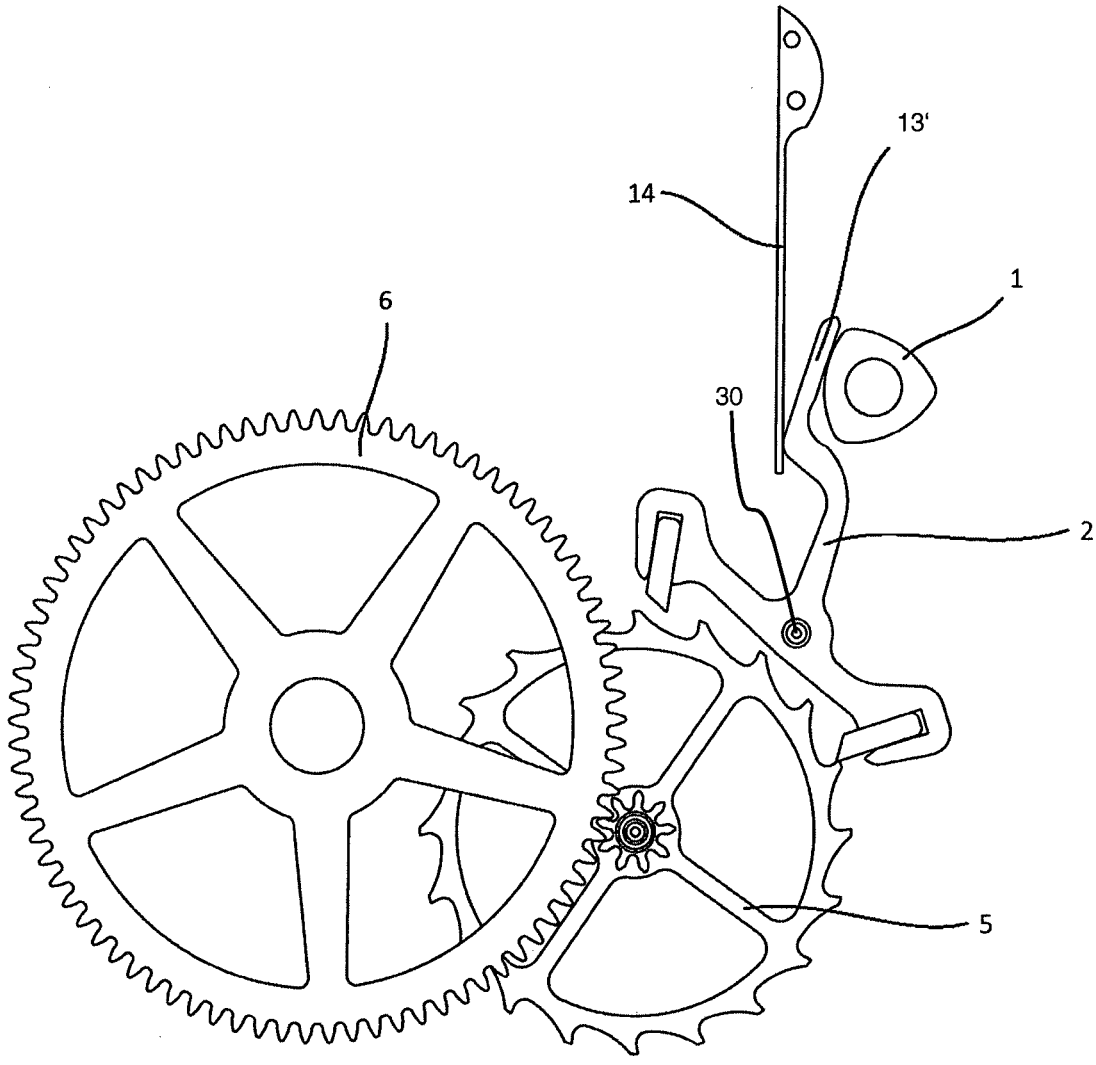


FIG. 11

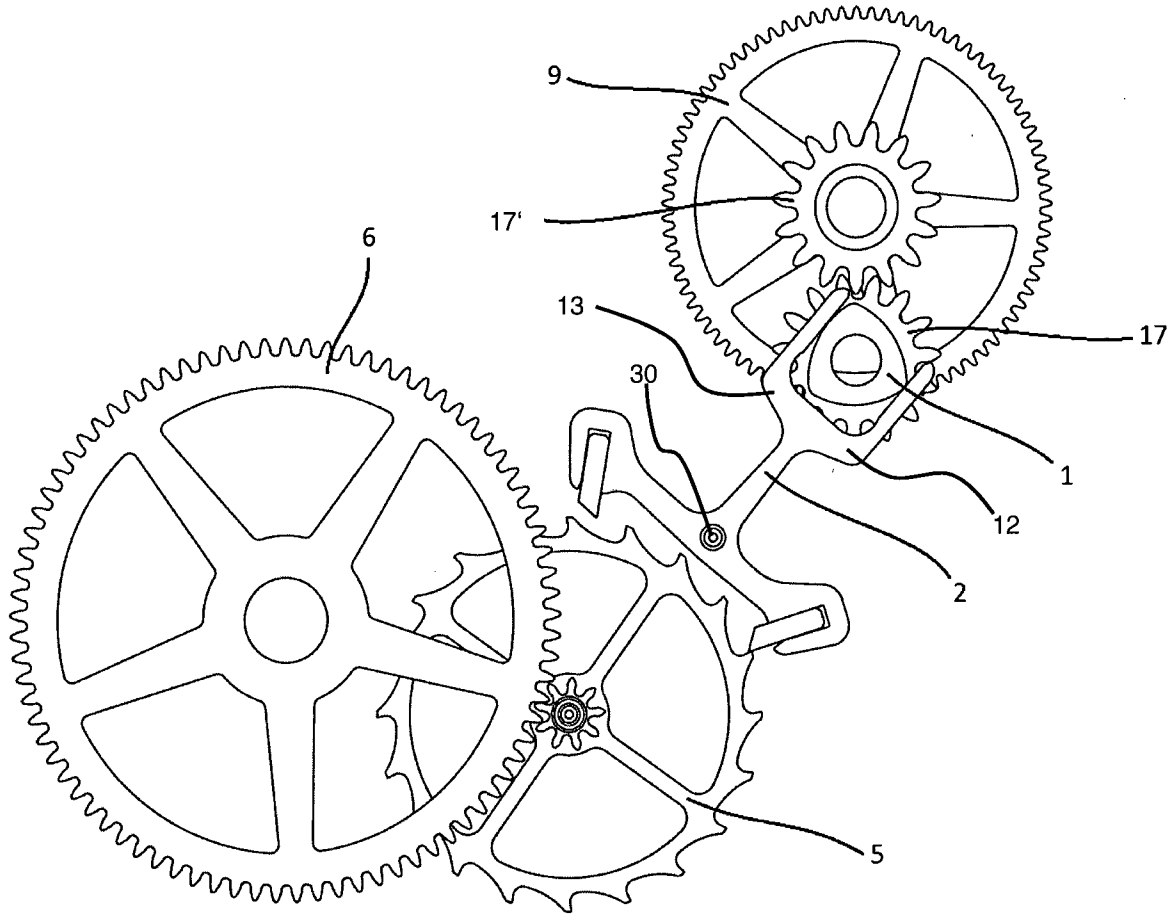


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/000115

A. CLASSIFICATION OF SUBJECT MATTER
INV. G04B1/22
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/113757 A1 (COMPLITIME SA [CH]; FORSEY STEPHEN [CH]; GREUBEL ROBERT [CH]) 22 September 2011 (2011-09-22)	1-3,5,8, 10,11, 13,15, 16,18
Y	abstract; figure 1 paragraphs [0001], [0010], [0028] - [0049]	4,9
X	DE 10 2014 117436 B3 (LANGE UHREN GMBH [DE]) 5 November 2015 (2015-11-05) paragraphs [0023], [0024], [0036], [0041]; figure 1	1,7,11, 17
Y	US 4 641 975 A (HEPFER ROLF [DE] ET AL) 10 February 1987 (1987-02-10) figure 2	4

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
9 June 2017	21/06/2017

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/000115

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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