

Secular module for a perpetual calendar mechanism of a watch movement

Technical field

[0001] The present invention relates to a secular module for a perpetual calendar mechanism for a watch movement. The secular module is intended to actuate a correction device to manage the transition from the end of February to March 1st according to leap years, while taking into account the absence of leap years every one hundred years and, optionally, maintaining leap years every 400 years.

State of the art

[0002] There are various mechanisms for displaying date-related information. These mechanisms are of relatively simple construction for basic date display without correction, of the annual calendar type, capable of managing the transition from months with 30 and 31 days to the first of the following month, and of the perpetual calendar type, which includes a mechanical memory, so to speak, allowing not only for the management of the transition from months with 30 or 31 days to the 1st of the following month, but also the transition from the end of February to March 1st, taking leap years into account. Conventional perpetual calendars, however, do not take into account the absence of leap years every one hundred years.

[0003] Various secular calendar mechanisms have already been described. However, one of the challenges remains maintaining an acceptable level of compactness. Another aspect is the ability to easily integrate a secular module capable of actuating a correction device to manage the transition from the end of February to March 1st based on leap years, taking into account the absence of leap years every hundred years and, optionally, maintaining leap years every 400 years. This type of secular module is notably described in publications EP3339973 and CH653841.

[0004] An aim of the present invention is therefore to propose a secular module capable of actuating a correction device to manage the transition from the end of February to March 1st according to leap years, taking into account the absence of leap years every hundred years.

[0005] Another aim of the present invention is to propose a secular module that is easy to modify to actuate the correction device, also taking into account leap years every 400 years.

[0006] Another aim of the present invention is to propose a reversible secular module to allow for easy correction of the year display in both directions, namely in both the incrementing and decrementing directions.

[0007] An additional aim is to propose a secular perpetual calendar incorporating the secular module.

Brief summary of the invention

[0008] These aims are achieved, in particular, by a secular module for a perpetual calendar mechanism, comprising three mobiles mounted in series, one of which is arranged to be driven by a month mobile. The first mobile preferably comprises a driving member, a cam, referred to as a leap year cam, and a driven member arranged to be rotated by a finger of the month mobile. The leap year cam and the driving member of the first mobile are fixed to the driven member. The second mobile comprises a driven member arranged to be rotated by the driving member of the first mobile, a cam, referred to as a decade cam, and a driving member comprising typically a finger. The decade cam and the driving member of the second mobile are fixed to the driven member. The third mobile comprises a rotary member arranged to be driven by the finger of the driving member of the second mobile, and a cam, referred to as a century cam, fixed to the rotary member.

[0009] The secular module further comprises a first and a second lever. The first lever comprises a feeler arranged to engage with the leap year cam of the first mobile to move the first lever into a first or a second position. The first lever is in the first position when the feeler engages with a first portion of the leap year cam corresponding to a non-leap year. The first lever is in the second position when the feeler engages with a second portion of the leap year cam corresponding to a leap year, in order to actuate a correction device to take into account the 29th day of February in a leap year.

[0010] The second lever comprises a first and a second feeler arranged to engage with the decade cam of the second mobile and the century cam of the third mobile, respectively. The second lever is arranged to keep the first lever in the first position when the first and second feelers are positioned on a portion of the cams corresponding to a multiple of ten years of the decade cam and a multiple of one hundred years of the century cam, respectively.

[0011] According to an embodiment, the secular module further comprises a finger fixed to the rotary member of the third mobile, a fourth mobile, as well as a third lever. The fourth mobile comprises a rotary member arranged to be driven by the passage of the finger, and a cam, referred to as a 400-year cam, fixed to the rotary member of this fourth mobile. The third lever comprises a third feeler to engage with the 400-year cam. The third lever is arranged to pivot the second lever so that the latter does not act on the first lever when the third feeler of the third lever engages with a portion of the 400-year cam corresponding to a multiple of 400 years.

[0012] According to an embodiment, the 400-year cam comprises two diametrically opposed recesses.

[0013] According to an embodiment, the rotary member of the third mobile and the driven member of the first mobile each take the form of a pinion with several pairs of teeth. These pairs of teeth are evenly distributed around the circumference of the pinion and are spaced apart from one another to define gaps.

[0014] According to an embodiment, the driving member of the second mobile and the driving member of the month mobile each have a circular edge, a finger whose free end protrudes from the circular edge, and two grooves arranged on either side of the finger. This allows each of these fingers to fit into the space formed by a pair of teeth on the respective pinion of the first and third mobiles, while each tooth of this pair of teeth can alternately fit into the first groove downstream of the finger relative to its direction of rotation, and into the second groove arranged upstream of said finger.

[0015] According to an embodiment, two adjacent pairs of teeth of the respective pinion are arranged so that one of the teeth from each adjacent pair of teeth come into abutment with the circular edges of the driving member of the month mobile and the driving member of the second mobile, thereby limiting the angular movement of the respective pinions of the first and third mobiles. These pinions are thus immobilized in a relatively stable position after each passage of the finger driving a pair of teeth, until the next passage of the finger engaging an adjacent pair of teeth. This arrangement prevents any unintended rotation of the driven members of the first and third mobiles in case one of them were to move in either direction, for example, in the event of a shock.

[0016] According to an embodiment, the secular module further comprises a jumper spring arranged to bear against a bearing zone of one of the gaps of the pinion of the third mobile, in order to bring the pinion into an indexed angular position.

[0017] According to an embodiment, the pairs of teeth of the pinions of the first and third mobiles respectively are obtained from a pinion in which every third tooth has been truncated.

[0018] According to an embodiment, the first mobile is arranged to be driven by the finger of the month mobile at a rate of one revolution every multiple of four years, preferably one revolution every eight or twelve years. The second mobile is arranged to be driven by the driving member of the first mobile at a rate of one revolution every ten years. The rotary member of the third mobile is arranged to be driven by the finger of the second mobile at a rate of one revolution every hundred years.

[0019] According to an embodiment, the leap year cam of the first mobile comprises two diametrically opposed recesses or three recesses spaced apart from each other by 120°. The decade and century cams each have a single recess.

[0020] According to an embodiment, the secular module further comprises an indexing star fixed to the first mobile and an indexing jumper spring cooperating with the indexing star to bring the first mobile into an indexed position after each passage of the finger of the month mobile.

[0021] According to an embodiment, the first lever further comprises a rake arranged to mesh with a toothing of the correction device.

[0022] Another aspect of the invention relates to a display module for displaying the years, comprising the above-mentioned secular module according to any of its embodiments, in which the third mobile further comprises a second rotary member arranged to be driven by the driven member of the second mobile at a rate of one revolution every ten years. The third mobile also comprises an axle fixed to the second rotary member and a pipe arranged around the axle and fixed to the first rotary member. The display module further comprises a units ring mounted fixed to the axis and a decade ring arranged concentrically outside the units ring and fixed to the pipe.

[0023] Another aspect of the invention relates to a perpetual calendar mechanism. This mechanism comprises, in particular, a months cam comprising at least one notch whose depth corresponds to the month of February in a non-leap year, as well as a correction device to limit the depth of said at least one notch so that it corresponds to the month of February in a leap year. The mechanism further comprises the above-mentioned secular module, according to any of its embodiments, so that the pivoting of the first lever into the second position actuates the correction device to limit the depth of said at least one notch.

[0024] Another aspect of the invention relates to a timepiece comprising the above-mentioned display module or perpetual calendar mechanism.

Brief description of the figures

[0025] Embodiments of the invention are provided in the description, illustrated by the appended figures, in which:

- Figure 1 illustrates a perspective view of a secular module arranged to be driven by a month mobile of a timepiece mechanism, according to an embodiment ;
- Figure 2 illustrates a perspective view of the secular module of Figure 1 from another orientation ;
- Figures 3a and 3b illustrate views of the secular module of Figures 1 and 2, with a cross-section at the cams, according to two operational sequences of the module;
- Figure 4 illustrates a top view of a year display comprising the secular module of Figure 1, and
- Figure 5 illustrates a simplified exploded view of a secular module according to another embodiment.

Examples of embodiments of the invention

[0026] According to an embodiment and with reference particularly to Figures 1 and 2, the secular module 10 is arranged to engage with a month mobile 100 of a watch movement and is adapted to take

into account the absence of leap years every 100 years. The secular module 10 can also be adapted to take into account leap years every 400 years, according to an advantageous embodiment that will be described later.

[0027] In fact, it is known that a leap year is a year that has 366 days instead of 365, with an additional day in the month of February. Years are generally leap years if they are multiples of four, however, they are not leap years if they are multiples of 100, except for those that are multiples of 400, which are leap years. Thus, the years 2020, 2024, and 2028 are leap years, as are the years 2000 and 2400, but not the years 1900, 2100, 2200, and 2300.

[0028] This type of year exists to compensate for the time difference between the common calendar year of 365 days and the solar year, which is the time required for the Earth to complete a full revolution around the Sun, amounting to 365.242 days. Therefore, an extra day must be added regularly to ensure that the average length of calendar years is as close as possible to the solar year by applying a correction according to the aforementioned rule.

[0029] In order to take into consideration the absence of leap years every hundred years, the secular module 10, illustrated in Figures 1 and 2, includes three mobiles 20, 30, 40 engaged directly or indirectly with the month mobile 100 and two levers 70, 80, each arranged to engage with at least one of these mobiles, enabling the actuation, every four years except every hundred years, of a correction mechanism that will be described later.

[0030] The month mobile 100 typically includes a pinion 102 with twelve teeth, a jumper spring 108 engaged with the pinion 102 as well as a first driving member 104 fixed to the pinion 102 and comprising a finger 105. The pinion 102 is arranged to be driven by the watch movement to complete a revolution of 360° every twelve months, preferably in successive steps of 30°. To achieve this, at the end of the month of December typically, the pinion 102, under the effect of the jumper spring 108, imparts a near-instantaneous rotation to the finger 105, thereby driving the first mobile 20 with a predetermined angular step in a nearly instantaneous manner.

[0031] The first mobile 20 includes a driving member 27, such as a wheel, on which are coaxially stacked a cam 25, referred to a leap year cam, a driven member 21 and preferably an indexing star 24. The driving wheel 27, the leap year cam 25, the indexing star 24, and the driven member 21 are fixed

together to form a unitary block. The driven member 21 is arranged to be rotated by the finger 105 of the month mobile 100 so that all the components of the first mobile 20 can rotate together by 360° every multiple of four years, particularly every eight years according to the preferred embodiment. The leap year cam 25 thus completes a full 360° rotation every eight years.

[0032] The second mobile 30 comprises a driven member or element 37, such as a wheel or pinion, on which are coaxially stacked a cam, referred to as a decade cam 35, and a second driving member 31, which includes a finger 32. The driven wheel 37, the decade cam 35 and the second driving member 31 are fixed together to form a unitary block, as with the first mobile 20. The driven wheel 37 of the second mobile 30 is in mesh with the driving wheel 27 of the first mobile 20. The gear ratio between these two wheels 27, 37 is 8:10 in this example, so that all the components of the second mobile 30 can complete together a revolution of 360° every ten years. The decade cam 35 thus completes a revolution of 360° every ten years.

[0033] The third mobile 40 includes a first rotary member 41 arranged to be driven by the finger 32 of the second driving member 31 of the second mobile 30, a cam 45, referred to as a century cam, fixed to the first rotary member 41 and a second rotary member 47 in mesh with the driven wheel 37 of the second mobile 30. The first rotary member 41 is thus driven by the finger 32 of the second driving member 31 of the second mobile 30 to complete a revolution of 360° every hundred years. The century cam 45 thus completes a revolution of 360° every hundred years. The gear ratio between the driven wheel 37 of the second mobile 30 and the second rotary member 47 is 1:1 so that the latter can also complete a revolution of 360° every ten years.

[0034] The month mobile 100 and the three mobiles 20, 30, 40 of the secular module 10 are therefore arranged in series. The transmission between these different mobiles can be done in various ways. For example, as shown in Figure 1, the driven member 21 of the first mobile 20 as well as the first and second rotary members 41, 47 of the third mobile 40 may take the form of pinions. As illustrated, these pinions preferably have a special toothing with several pairs of teeth 22, 42 regularly spaced around their circumference to define gaps 23, 43 between the pairs of teeth.

[0035] More specifically, the pinion 21 of the first mobile 20 may, for example, have eight pairs of teeth 22 and gaps 23 arranged between the pairs of teeth 22. This unique toothing is obtained from a

pinion with twenty-four teeth, where every third tooth has been truncated. The first driving member 104 of the month mobile 100 has a specific shape to drive the pinion 21. This driving member includes a disk with a circular edge 106 along almost its entire circumference, a finger 105 with a free end protruding from the circular edge 106 of the disk as well as a first and second groove 107a, 107b positioned on either side of the finger 105. Each groove 107a, 107b extends along a direction parallel to the axis of rotation of the month mobile 100 along the thickness of the disk.

[0036] Thus, at the end of each year, the finger 105 of the month mobile 100 fits into the space formed by a pair of teeth 22 of the pinion 21 of the first mobile 20 while the first and second teeth of this pair of teeth alternate to fit, respectively, into the first groove 107a downstream of the finger 105 relative to its direction of rotation, and into the second groove 107b positioned upstream of the finger 105. Therefore, after the passage of the finger 105, the pinion 21 continues to be temporarily driven under the action of the second groove 107b against the second tooth of the pair of teeth 22.

[0037] The indexing star 24 is arranged to engage with an indexing jumper spring 28. In the illustrated example, the star 24 has eight teeth, meaning the number of teeth of the star 24 corresponds to the number of pairs of teeth 22 of the pinion 21. The function of the indexing star 24 will be described later.

[0038] As with the first mobile 20, the first and second rotary members 41, 47 of the third mobile 40 can both take the form of pinions, each with ten pairs of teeth 42 evenly spaced over 360° to define gaps 43 arranged between the pairs of teeth 42. This tothing is obtained from a pinion of thirty teeth, where every third tooth has been truncated. Preferably, a first and a second jumper spring 53, 54 are arranged so that their respective heads 53a, 54a rest against a bearing surface of a gap 43 of the first and second pinions 41, 47, respectively, to bring both pinions 41, 47 into an indexed angular position.

[0039] When the finger 105 of the driving member 104 of the month mobile 100 engages a pair of teeth 22 of the pinion 21 of the first mobile 20, typically at the end of December each year, the first mobile 20 pivots by a certain angle. Consequently, the indexing star 24 is driven in rotation by the action of the finger 105, causing the indexing jumper spring 28 to be lifted until it imparts a jump to the first mobile 20, bringing it into an indexed angular position. The indexing star and jumper spring fulfil two functions.

[0040] The first function is to provide sufficient torque to the first mobile 20, which adds to the torque exerted by the jumper spring 108 on the pinion 102 of the month mobile 100 to ensure that the pinion 102 generates enough torque to drive the jumper springs 53 and 54 as well as the levers 70 and 80, allowing the pinion to jump one step. The second function consist in completing the rotation of the first mobile 20 so that it can make a jump of 45° at the end of each year. Each jump of the first mobile 20 enables the actuation of the third mobile 40, via the second mobile 30, so that the first pinion 41 and the second pinion 47 of the third mobile can make a jump of 36° at the end of every decade and every year, respectively. In the preferred embodiment, this jump also ensures that the heads 53a, 54a of the two jumper springs 53, 54 properly engage a bearing surface of one of the gaps of the two pinions 41, 47 of the third mobile 40, rather than a pair of teeth 42, in order to lock the third mobile 40 into an indexed position after each jump.

[0041] It should be noted that the indexing star 24 and the indexing jumper spring 28 are not essential for the proper functioning of the secular module. The rigidity of the jumper spring of the month mobile 100 could in fact be reduced so that the torque transmitted to this mobile is sufficient to trigger the jump and drive the first mobile 20 of the secular module 10.

[0042] Moreover, the unique shape of the driving member 104 of the month mobile and of the pinion 21 of the first mobile 20 allows the angular movement of the pinion 21 to be limited during the current year between two passes of the finger 105. This is made possible by two adjacent pairs of teeth of the pinion 21, which are arranged so that one tooth from each pair would come to abut against the edge 106 of the disc in the event that the first wheel 20 were to move in either direction, for example as a result of a shock.

[0043] Similarly, the first and second jumper springs 53, 54 acting on the third mobile 40 are not essential for the proper functioning of the secular module, because the more or less stable angular position of the first and second pinions 41, 47 is ensured by the unique shape of the second driving member 31 of the second mobile 30 and that of the first and second pinions 41, 47 of the third mobile 40, as explained above for the driving of the first mobile 20.

[0044] The unique shapes of the driving members 104, 31 of the first and third mobiles 20, 40 and of the respective pinions 21, 41 they drive, advantageously allow the reversibility of the secular module.

Reversibility refers to the ability to drive the first mobile 20 in either direction using the month mobile 100, allowing for easy correction of the year display, which will be explained later.

[0045] However, it is important to note that the unique shape of the driving members 104, 31 and that of the respective pinions 21, 41 are not essential for the proper functioning of the secular module. Pinions with a continuous toothing, along with suitable fingers to drive them, could indeed be used with appropriate jumper springs to ensure the indexing of the mobiles and their reversibility.

[0046] Furthermore, the gear ratio between the driving wheel 27 of the first mobile 20 and the driven wheel 37 of the second mobile 30, as well as the shape of the pinion 21 of the first mobile, could be different. For example, this gear ratio could be 12:10 and the pinion 21 could have twelve pairs of teeth instead of eight so that all the elements of the first mobile 20 can perform together a revolution of 360° every 12 years. In this case, the leap year cam would have three recesses arranged 120° apart from each other, as each recess represents a leap year according to a four-year cycle.

[0047] As shown, particularly in Figures 3a and 3b, the secular module 10 also includes a first lever 70 and a second lever 80. The first lever 70 is notably arranged to engage, on one hand, with the leap year cam 25 of the first mobile 20 and, on the other hand, with a correction device. In this regard, the first lever 70 further comprises transmission means to actuate the correction device when this first lever is brought into a certain position. In this example, the transmission means take the form of a rake 74 in mesh with a toothing of the correction device, which will be described later.

[0048] The second lever 80 is arranged to engage with the decade cam 35 of the second mobile 30 and with the century cam 45 of the third mobile 40. The second lever 80 is positioned in such a way as to move the first lever 70 based on the angular position of the decade cam 35 and of the century cam 45.

[0049] More specifically, the first lever 70 includes a feeler 72 and a lever spring 78 arranged to press the feeler 72 against the contour of the leap year cam 25 of the first mobile 20. The profile of this cam, in this example, has two diametrically opposed recesses 26a, 26b and two circular portions 26d, 26e. The second lever 80 includes a first feeler 81 and a second feeler 82. The first feeler 81 is arranged to feel the contour of the decade cam 35 of the second mobile 30. The profile of this cam, in this example, comprises a recess 36 and a circular portion 36a, which typically extends over more than 300°. The second feeler 82 is arranged to feel the contour of the century cam 45 of the third mobile 40. The profile of this cam, in

this example, comprises a recess 46 and a circular portion 46a, which preferably extends over more than 300°.

[0050] The second lever 80 further includes a lever spring 86 intended to press the first and second feelers 81, 82 against the profiles of the respective cams of the second and third mobiles 30, 40. This second lever 80 also comprises an actuating arm 83, one end 84 of which is intended to act on an actuatable part 76 of the first lever 70.

[0051] The combined consideration of the angular positions of the decade cam 35 and the century cam 45 allows for determining whether the current year is a multiple of 100 years, in which case it is not a leap year. Since the decade cam 35 completes a full revolution every ten years, while the century cam 45 completes a full revolution every hundred years, their respective recesses 36, 46 align at the same angular position every multiple of 100 years. In other words, by completing a revolution every ten years, the decade cam 35 can be considered an indicator of the unit of the current year. Similarly, by completing a revolution every hundred years, the century cam 45 can be considered an indicator of the decade of the current year. Thus, when the unit and the decade of the current year are both equal to zero, which correspond to a common direction or angular position of the recesses 36, 46 of these cams relative to their axis of rotation, it indicates that the current year is a multiple of one hundred.

[0052] The operation of the secular module 100 will be better understood through the description of the two operational sequences illustrated in Figures 3a to 3b.

[0053] According to Figure 3a, the decade cam 35 and the century cam 45 of the second and third mobiles 30, 40 are not in the same angular position. Therefore, the current year is not a multiple of 100 years. However, the angular position of the leap year cam 25 indicates that the current year is a leap year. The first lever 70 pivots, under the action of the jumper spring 78, so that its feeler 72 comes into contact with the bottom of the recess 26a. The pivoting of the first lever 70 actuate the rake 74, which is fixed to one of its arms, causing it to actuate in turn the correction device to take into account the 29th day of February.

[0054] **According to Figure 3b**, the decade cam 35 and the century cam 45 are in the same angular position. Therefore, the current year is a multiple of 100 years, meaning it is not a leap year. However, the leap year cam 25 is in an angular position where the recess 26a aligns with the feeler 72 of the first

lever 70. The second lever 80 pivots, under the action of the lever spring 86, when its first and second feelers 81, 82 come into contact with the bottoms of the recesses 36, 46 of the decade cam 35 and of the century cam 45, respectively. The pivoting of the second lever 80 allows the free end 84 of its actuating arm 83 to act on the actuatable part 76 of the first lever 70 in order to position its feeler 72 away from the bottom of the recess 26a of the leap year cam 25. This action may either prevent the feeler 72 from contacting the bottom of the recess 26a of the leap year cam 25 or lift this feeler 72 if it has already contacted the bottom of the recess or is in the process of pivoting toward the bottom of the recess. In the first case, the first lever 70 cannot move, which prevents the actuation of the correction mechanism for a correction that is not needed.

[0055] The third mobile 40 can, according to an advantageous embodiment shown in Figure 4, support a display 200 of the years. It comprises a units ring 210 and a decade ring 220 arranged concentrically outside the units ring 210, each comprising a sequence of digits from 0 to 9. According to Figure 1, the third mobile 40 also includes an axle 50 fixed to the second rotary member 47 and a pipe 44 arranged around the axle 50 and fixed to the first rotary member 41.

[0056] The units ring 210 comprises at its centre a fastening element 212 comprising a hub 213 fixed onto the axle 50 of the second rotary member 47 (Figure 1), for example by press-fitting, and several fastening arms 214 extending radially from the hub 213, with their free ends fixed to the underside of the units ring 210. The decade ring 220 also comprises at its centre a hub (not visible) arranged beneath the hub 213 of the units ring, and several fastening arms 222 extending radially from the hub, with their free ends fixed to the underside of the decade ring 220. The hub of the decade ring 220 is fixed to the pipe 44 of the first rotary member 41 (Figure 1), for example by press-fitting.

[0057] According to another embodiment schematized in Figure 5, the secular module is adapted not only to take into account the absence of leap years every hundred years, like the secular module 100 that has just been described, but also the years divisible by 400 as leap years, even though they are also divisible by 100.

[0058] To this end, the secular module comprises three mobiles and two levers identical or similar to the three mobiles 20, 30, 40 and the two levers 70, 80 as described previously for the embodiment shown in Figures 1 and 2. A transmission member 51 (comprising a finger 52) is mounted on the third

mobile to be fixed to the first rotary member 41 in order to be driven by a rotation of 360° every hundred years. The secular module further comprises a fourth mobile 60 and a third lever 90 as shown in Figure 5.

[0059] The fourth mobile 60 comprises a rotary member or element 62 arranged to be driven by the passage of the finger 52 associated with the third mobile 40. The rotary element may, for example, be in the form of a pinion 62 with eight pairs of teeth, like the pinion 21 of the first mobile 20 in Figure 1, so that pinion 63 can complete a rotation of 360° every 800 years. A cam, referred to as a 400-year cam 64, is connected to the pinion 62 so that this cam 64 can also complete a rotation of 360° every 800 years. The profile of this 400-year cam includes two diametrically opposed recesses 65a, 65b as well as two circular portions. The fourth mobile 60 could take other forms, particularly regarding the number of teeth or pairs of teeth of the pinion 62 and the number of recesses 65a, 65b on the cam 64. What matters is that the elements of the fourth mobile 60 can together complete a rotation of 360° every multiple of four hundred years.

[0060] The third lever 90 comprises a third feeler 92, a lever spring (not shown) to force the third feeler 92 to follow the profile of the 400-year cam as well as an actuating arm 94. The latter has a free end 95 intended to act on an actuatable part 85 of the second lever 80 so that the latter does not act on the first lever 70 when the third feeler 92 of the third lever 90 engage with either of the two recesses 65a, 65b of the 400-year cam corresponding to a multiple of 400. The first lever 70 can therefore pivot, under the action of its lever spring, thereby forcing its feeler 72 to reach the bottom of a recess 26c of the leap-year cam 25.

[0061] It should be noted that, in this example, the leap-year cam 25 has three recesses 26a, 26b, 26c arranged 120° apart from each other. Additionally, the driving wheel 27 of the first mobile and the driven wheel 37 of the second mobile have a gear ratio of 12:10, so that the second mobile, which includes the decade cam 35, can complete a full revolution every ten years when the first mobile completes a full revolution every twelve years.

[0062] The secular module 10, according to one of the aforementioned embodiments, is intended to be incorporated into a perpetual calendar mechanism, preferably equipped with a month cam (not shown) with thirty-six notches or fewer. This contrasts with most conventional perpetual calendars, which

are equipped with a month cam with forty-eight notches, commonly referred to as the “48 cam” to cover a four-year cycle that includes a leap year.

[0063] The thirty-six notches of the month cam extend toward the centre of the cam and have three different depths. These notches are arranged in sequence according to the lengths of the months from January to December. The shallowest notches correspond to months with 31 days, the deepest notches correspond to months with 28 days, and the intermediate notches correspond to months with 30 days.

[0064] This month cam has the advantage of being more compact compared to a 48 cam while maintaining notches of the same width. Consequently, the cam represents only a cycle of three consecutive years, with three notches arranged 120° apart from each other for the correction at the end of February in non-leap years.

[0065] To further reduce the size of the month cam, this cam could, according to other embodiments, comprise only twenty-four notches, or even twelve notches, while maintaining notches of the same width as those of a 48 cam.

[0066] Regardless of the number of notches for the month cam (12, 24, 36, or even 48 notches), the February months of such a cam would be represented by notches with a depth corresponding to 28 days. Consequently, the month cam does not include any notch dedicated to the correction needed for February in a leap year.

[0067] To make this correction, the perpetual calendar mechanism includes a correction device intended to reduce the depth of the February notch during a leap year so that the depth corresponds to a month of 29 days.

[0068] The correction device includes a rotary member in the form of a disk mounted coaxially with the month cam, for example, in the same plane as the cam. The disk has a circular portion, a radial slit, and tothing on its perimeter. The rack 74 of the first lever 70 of the secular module engages with the tothing of the disc so as to pivot the disc such that its radial slot is aligned with the notch for the month of February on the month cam during a common year, and conversely, that the radial slot is not aligned with the February notch during a leap year.

Reference list

Secular module 10

First mobile 20

Driven member 21 (e.g. pinion)

Pair of teeth 22

Gap 23

Indexation star 24

leap year cam 25

Recesses 26a, 26b ; 26a, 26b, 26c

Circular portions 26d, 26e

Driving member 27

Indexation jumper spring 28

Second mobile 30

Driving member 31

Finger 32

Circular edge 33

Groove 34

Decade cam 35

Recess 36

Circular portion 36a

Driven member 37

Third mobile 40

First rotary member 41 (e.g. pinion)

Pair of teeth 42

Gap 43

Pipe 44

Century cam 45

Recess 46

Circular portion 46a

Second rotary member 47 (e.g. pinion)

Pair of teeth 48

Recess 49

Axle 50

Transmission member 51

Finger 52

First and second jumper springs 53, 54

Heads 53a, 54a

Fourth mobile 60 (e.g. pinion)

Rotary member 62

400-year cam 64
Recesses 65a, 65b

First lever 70
Feeler 72
Rake 74
Actuatable part 76
Lever spring 78

Second lever 80
First feeler 81
Second feeler 82
Actuating arm 83
Free end 84
Actuatable part 85
Lever spring 86

Third lever 90
Third feeler 92
Actuating arm 94
Free end 95
Lever spring 96

Month mobile 100
Pinion 102
Driving member 104
Finger 105
Circular edge 106
Grooves 107a, 107b
Jumper spring 108

Display module 200
Units ring 210
Fastening element 212
Hub 213
Fastening arms 214
Decade ring 220
Fastening arms 222

Claims

1. Secular module (10) for a perpetual calendar mechanism of a watch movement, comprising a first mobile (20) comprising a driving member (27), a cam (25), referred to as a leap year cam, and a driven member (21) arranged to be rotated by a driving member (104) of a month mobile (100) of the watch movement, the leap year cam (25) and the driving member (27) being fixed to the driven member (21), a second mobile (30) comprising a driven member (37) arranged to be rotated by the driving member (27) of the first mobile (20), and a second driving member (31) fixed to the driven member (37), a third mobile (40) comprising a rotary member (41) arranged to be driven by the second driving member (31) of the second mobile (30), a cam (45), referred to as a century cam, fixed to the rotary member (41), and a first lever (70) comprising a feeler (72) arranged to engage with the leap year cam (25) of the first mobile (20) to move the first lever (70) into respectively a first position when the feeler (72) engages with a first portion of the leap year cam (25) corresponding to a non-leap year, and a second position when the feeler (72) engages with a second portion (26a, 26b, 26c) of the leap year cam (25), corresponding to a leap year, in order to actuate a correction device to take into account the 29th day of February in a leap year, and

characterized in that the second mobile (30) further comprises a cam (35), referred to as a decade cam, fixed to driven member (37) of said second mobile and **in that** the secular module (10) further comprises a second lever (80) comprising a first and a second feeler (81, 82) arranged to engage with the decade cam (35) of the second mobile (30) and the century cam (45) of the third mobile (40), respectively, the second lever (80) being arranged to act on the first lever (70) in order to prevent its feeler (72) from cooperating with said second portion of the leap year cam (25) when the first and second feelers (81, 82) of the second lever (80) are positioned on a portion of the cam corresponding respectively to a multiple of ten years of the decade cam (35) and a multiple of one hundred years of the century cam (45).

2. Secular module (10) according to claim 1, further comprising a finger (52) fixed to the rotary member (41) of the third mobile (40), a fourth mobile (60) comprising a rotary member (62) arranged to be driven by the passage of the finger (52), and a cam (64), referred to as a 400-year cam, fixed to the rotary member (62), a third lever (90) comprising a third feeler (92) arranged to engage with the 400-year cam (64), the third lever (90) being arranged to pivot the second lever (80) so that the latter does not act on the first lever (70) when the third feeler (92) engages with a portion (65a, 65b) of the 400-year cam (64) corresponding to a multiple of 400 years.

3. Secular module (10) according to the preceding claim, wherein the 400-year cam (64) comprises two diametrically opposed recesses (65a, 65b).
4. Secular module (10) according to any one of preceding claims, wherein the rotary member (41) of the third mobile (40) and the driven member (21) of the first mobile (20) each take the form of a pinion with several pairs of teeth (42) evenly distributed around their circumference and spaced apart from one another to define gaps (23, 43).
5. Secular module (10) according to the preceding claim, wherein the second driving member (31) of the second mobile (30) and the driving member (104) of the month mobile (100) each have a circular edge (33, 106), a finger (32, 105) whose free end protrudes from the circular edge (33, 106), and two grooves (34, 107a, 107b) arranged on either side of the finger (32, 105), said grooves (34, 107a, 107b) being shaped to receive the teeth of the respective pinions (41, 21), and the fingers (32, 105) being shaped to engage within said pairs of teeth (22, 42).
6. Secular module (10) according to the preceding claim, wherein the adjacent teeth of two successive pairs of teeth (22, 42) are shaped to abut against the circular edge (33, 106) of the driving member (31, 104) associated with the pinion (41, 21) of said pairs of teeth, in order to limit the angular play of said pinions (21, 41) after each passage of the finger (32, 105) of the driving member (31, 104).
7. Secular module (10) according to any one of claims 4 to 6, further comprising a jumper spring (53) arranged to bear against a bearing zone of one of the gaps (43) of the pinion (41) of the third mobile (40), in order to bring the pinion (41) into an indexed angular position.
8. Secular module (10) according to any one of claims 4 to 7, wherein the pairs of teeth of the pinions (21, 41) of the first and third mobiles (20, 40) respectively are obtained from a pinion in which every third tooth has been truncated.
9. Secular module (10) according to any one of claims 4 to 8, wherein the first mobile (20) is arranged to be driven by the finger (105) of the month mobile (100) at a rate of one revolution every multiple of four years, preferably one revolution every eight or twelve years,
the second mobile (30) is arranged to be driven by the driving member (27) of the first mobile (20) at a rate of one revolution every ten years, and

the rotary member (41) of the third mobile (40) is arranged to be driven by the finger (32) of the second mobile (30) at a rate of one revolution every hundred years.

10. Secular module (10) according to any one of preceding claims, wherein the leap year cam (25) of the first mobile (20) comprises two diametrically opposed recesses (26a, 26b) or three recesses (26a, 26b, 26v) spaced apart from each other by 120°, and the decade cam (35) and the century cam (45) each having a single recess (36, 46).

11. Secular module (10) according to any one of preceding claims, further comprising an indexing star (24) fixed to the first mobile (20) and an indexing jumper spring (28) cooperating with the indexing star (24) to bring the first mobile (20) into an indexed position after each passage of the finger (105) of the month mobile (100).

12. Secular module (10) according to any one of preceding claims, wherein the first lever (60) further comprises a rake (74) arranged to be in mesh with a toothing of the correction device.

13. Display module (200) for displaying years, comprising the secular module (10) according to any one of the preceding claims, wherein the third mobile (40) further comprises a second rotary member (47) arranged to be driven by the driven member (37) of the second mobile (30) at a rate of one revolution every ten years, an axle (50) fixed to the second rotary member (47), and a pipe (44) arranged around an axle (50) and fixed to the first rotary member (41), the display module (200) further comprising a units ring (210) fixed to said axle (50), and a decade ring (220) arranged concentrically outside the units ring (210) and fixed to said pipe (44).

14. Timepiece comprising the secular module (10) according to any one of claims 1 to 12 or the display module (200) according to claim 13.