

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) HOROLOGICAL REGULATOR

(71) We, TIMEX CORPORATION, a Corporation organised under the laws of the State of Delaware, United States of America, of Waterbury 20, Connecticut, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to horology and more particularly to a regulator for a mechanical horological movement.

In balance wheel watches, in which an oscillating balance wheel is connected to one end of a hairspring, the frequency of oscillation of the balance wheel can be changed by altering the effective length of the hairspring. This is done conventionally by a regulator which is swivelingly arranged on a balance bearing and operates on the other end portion of the hairspring, near to its point of "attachment" to the frame. One type of conventional regulator has two banking points which are arranged on both sides of the hairspring and effectively become one end point of the movable portion of the hairspring. In many regulators, these banking points are at a small radial distance from the hairspring, i.e., they are separated by more than the thickness of the hairspring. During oscillation of the balance wheel the hairspring moves radially from one banking point to the other and furthermore executes a small longitudinal movement between the banking points in a tangential direction, caused by the deformation of the hairspring. These are influences on the directive movement of the hairspring and consequently cause an undesirable change of the frequency.

It has been tried to overcome this disadvantage by tightly pressing the banking points against the hairspring without leaving a gap. This arrangement keeps the respective hairspring ends in place, but the influence of the residual length of the spring, namely that portion between the banking points of the regulator and the

attachment at the frame, is not eliminated. The residual length of spring also carries out movements, to a certain extent, that have an unfavourable effect on the constancy of the frequency. In addition, the arrangement has the disadvantage that the regulator is difficult to adjust. It is either necessary to lift the tightly pressed banking points off the hairspring, which is partly done by a complicated design whereby one banking point is automatically lifted off on adjustment, or the banking points are shaped like rollers that rotate on the hairspring during adjustment. These aforementioned designs, i.e., the automatic lifting of at least one banking point when adjusting the regulator, as well as the rotating of the rollers, are relatively complicated and therefore expensive. In the arrangement in which the hairspring is loosened by lifting off one banking point, there is the disadvantage that, while adjusting the regulator (when the hairspring is lifted off one banking point) the frequency of the oscillating system does not correspond to the final frequency (when both banking points are tightly pressed again). The hairspring must always be clamped during the adjustment before measurements can be carried out.

It is an object of the present invention to provide a regulator whose adjustment is largely uninfluenced by the residual length of the hairspring, i.e., that portion of the length which lies between the regulator and the end of the hairspring fixed to the frame.

According to the present invention, there is provided a regulator for regulating the frequency of a horological mechanical oscillator, the oscillator comprising an oscillator mass and at least one spring attached at one end to the oscillator mass and at its opposite end to a fixed attachment point, said regulator including an adjustment device and a stabilisation device, said adjusting device including a forked member adjustable along the spring to vary its effective length, said stabilisation device including a member for holding the residual portion of the spring between the point of

[Price 25p]

action of the adjusting member and the attachment point and adjustable along the residual portion of the spring.

The stabilisation member controls the position of the residual portion of the spring. Most suitably the stabilisation member is arranged such that during the movement of the oscillator the residual portion of the spring largely remains at rest. Practically no influence is therefore exercised from this residual portion of the spring on the frequency of the oscillator. The stabilisation members can be shaped in various ways. An especially simple design results when both the stabilisation and the adjusting members are forked and have fork tines between which the spring is drawn. Favourable clamping of the spring at the selected points results if the spring then rests under elastic pressure against the tines. It can be sufficient if the two members have only two fork tines each. These fork tines are arranged, relative to the spring, so that they encompass the spring on opposite sides thereof at positions spaced longitudinally of the spring. The elastic bearing of the spring against the fork tines can easily be obtained, especially if the spring is somewhat deformed in passing between the fork tines.

It is advantageous if the stabilisation member is movable relative to the adjustment member within a predetermined limited range. The two members, however, should always remain at a sufficient distance apart to maintain stabilisation. To keep the distance, it is preferable that the two members are coupled by a lost-motion connection, so that the adjustment member can at first carry out an initial movement from its starting position before the stabilisation member is entrained. This lost-motion connection may be effective in one or both directions of adjustment.

When the adjustment member is moved in the direction away from the point of attachment, the use of a lost-motion connection creates no problems. However, when readjustment in the opposite direction is carried out and the adjustment member is moved towards the stabilisation member, the latter remains in its position during initial movement of the adjustment member and there thus arises a danger that the portion of spring between the two members may become buckled. In case of adjustment away from the point of attachment, the problem does not arise. Hence, when dimensioning the range of permitted relative movement of the two members, the maximum distance apart of the two members should not be so great that the portion of the spring which extends between them is likely to buckle when the adjust-

ment member is readjusted in the direction towards the stabilisation member.

The invention is not restricted to any particular kind of spring; the spring may be of any desired kind, and not necessarily a flat hairspring, although a spiral spring or a helical spring having a central rotation axis is usual. With such a sprung it is advantageous if the two members are arranged coaxially with each other and preferably also coaxially to the axis of oscillation of the oscillator. Thereby the two members can be arranged directly one upon the other and slide one upon the other during the adjustment.

The stabilisation member, when moving, can advantageously be guided by one or more cam faces provided on the adjustment member and/or stationary parts, for example, parts of a frame plate or a bridge. Preferably the stabilisation member is pressed against the cam faces by the spring, in order to be guided safely.

Two preferred embodiments of the present invention will now be described with reference to the accompanying drawings. In the drawings:

Fig. 1 is a plan view, taken on line I—I of Fig. 2 of part of a mechanical watch movement showing a balance wheel provided with a first embodiment regulator, the balance bridge being shown partly broken away;

Fig. 2 is a section taken along the line 2—2 of Fig. 1;

Fig. 3 is a side view of the direction of the arrow A of Fig. 1;

Fig. 4 is a partial plan view corresponding to Fig. 1 but considerably enlarged to show the hairspring in relation to the adjustment member and the stabilisation member of the regulator;

Fig. 5 is an enlarged perspective view showing the reciprocal coordination of the adjustment member and the stabilisation member of the regulator according to Fig. 1;

Fig. 6 is a plan view of part of a mechanical watch movement showing a balance wheel provided with a second embodiment of regulator the balance bridge again being partly broken away;

Fig. 7 is a section taken along the line 7—7 of Fig. 6;

Fig. 8 is a partial plan view corresponding to Fig. 6 but considerably enlarged in order to show the essential parts for the functioning of the regulator; and

Fig. 9 is an enlarged perspective view showing the reciprocal coordination of the adjustment member and the stabilisation member of the regulator according to Fig. 6.

The balance wheel, shown in Figs. 1 to 3, has a balance rim 10 and a spoke 12, which

is positioned as a press fit in the know way, on a balance staff 14. The oscillator mass (comprised of the balance rim, spoke and balance staff) is pivotally positioned in 5 jewel bearings between a frame plate 16 of the watch movement and a balance bridge 18. The balance bridge 18 is kept at a distance, parallel to the movement plate 16, by a pillar 20 and set pins 26 and 28. 10 Pillar 20 and bridge 18 may be separated from one another, and loosened from the movement plate 16, by means of screws 22 and 24, respectively.

The jewel bearing positioned in the balance bridge 18 is set in a bearing bushing 30 which is inserted in a recess of the bridge. Its opposite jewel bearing is positioned in the frame plate 16. The construction of the jewel bearings is generally 20 known. They have a bearing ring 34 carrying the shouldered end 32 of the balance staff, said bearing ring being covered by a plate 36 which supports the shouldered end 32 of the balance staff. As shown in Fig. 2, a flange 38 is shaped on the 25 bearing bushing 30. Flange 38 is spaced from the lower side of the balance bridge 18 (according to Fig. 2).

A conventional hairspring hub 40 is arranged, between the balance rim 10 and the balance bridge 18, on the balance staff to tie the inner end of a flat spiral hairspring 42 to the oscillator mass. The outer end 44 of hairspring 42 is kept by a pin 50 35 in an arm 48. The arm 48 is arranged on the balance bridge and extends from that bridge downwards (according to Fig. 3).

A regulating device 52 is coordinated with the hairspring to adjust its effective length whereby the regulating device 52 adjusts the frequency of the oscillator. The regulator device 52 includes an adjustment member 54 and a stabilisation member 56. These two members cooperate with the 45 outer hairspring coil, i.e. the coil which is fixed to the attachment arm 48. For changing the frequency of the oscillator, the effective length of the outer hairspring coil is changeable in the generally known way. It is furthermore made certain that the 50 residual portion of the hairspring (the portion of the hairspring between the point of action of the adjustment member and the attachment point) is stabilised. The residual portion of the spring cannot move and therefore does not have any disadvantageous effect on the frequency of the oscillator. 55

The design of the regulating device 52 is described in detail by reference to Figures 60 4 and 5. The adjustment member 54 has a fork head 55 whose fork tines 60 and 62 are arranged axially parallel to the balance staff. The two fork tines 60 and 62 extend downwards with their free ends defining a first passage (slot) 64. The stabi- 65

isation member 56 also has a fork head 37 whose fork tines 66 and 68 define a second spring passage 70. The stabilisation fork tines 66 and 68 extend in the same direction as the fork tines 60 and 62 and are also arranged parallel to the balance staff. Each of the two fork heads is attached to a carrying arm. The fork head 55 is carried by a carrying arm 72 which extends radially of the jewel bearing in the balance 70 bridge. The carrying arm 74, for the fork head 57, likewise extends radially of the same jewel bearing. 75

The carrying arm 72 has an integral sliding ring 76 which is slotted at 78 so that it acts as a spring ring. The carrying arm 74 is integral with a second sliding ring 80, said sliding ring 80 being likewise shaped as a spring ring by a slot 82. These two sliding rings 76, 80 are arranged coaxially 85 with each other, on the bearing bushing 30, between the balance bridge 18 and the bushing flange 38 (see Fig. 2). The inner diameters of the two sliding rings are chosen somewhat smaller than the outer diameter of the bearing bushing, to obtain a relatively high friction, so that additional safeguards against inadvertent rotation of the sliding rings on the bearing bushing is not required. 90 95

As shown in Figs. 1 and 5, the adjustment member 54 has a regulating lever 84 by means of which the adjustment member 54 can be adjusted in both directions. Furthermore, at the outer circumference of the sliding ring 76, a driving nose 86 is directed downwards at a fixed angular distance from the carrying arm 72. A banking extension 88, at the outer circumference of the ring 80 of the stabilisation member 56, is coordinated with the driving nose 86. This banking point 88 is formed so that it is at a certain fixed angular distance from the carrying arm 74. The driving nose 86 engages between the extension point 88 and the arm 74. The width of the driving nose 86 is chosen so that the adjustment member 54 can move through a predetermined angle of rotation before it drives the stabilisation member. 100 105 110 115

As shown in Fig. 4, the fork heads 55, 57, seen in plan view, are arranged not at 90° but obliquely to the longitudinal direction of their carrying arms 72 and 74 respectively. The outer turn of the hairspring coil is led through the slotted passages of the two fork heads. The oblique arrangement of the fork heads is such that the fork tines 60 and 66 bear against the inner side 90 of the outer spring coil while the fork tines 62 and 68 bear against the outer side 92 of the outer hairspring coil. Because of the oblique arrangement of the fork heads, the hairspring is reversely bent in passing through the passages 64 and 70 so that it 120 125 130

is held in a deformed condition and bears against the tines of the fork heads under elastic pressure.

5 The hairspring is held in place between the fork tines so that the fork tine 60 (of the fork head 55) creates an end point of resilience for the outer coil of the spring. The residual portion 58 of the spring 42 extending from this end point of resilience to the attachment arm 48 is kept firmly in position 10 by the fork head 57. This portion 58 of the spring is held in the head 57 regardless of whether the adjustment member 54 is at rest or moves; if this portion of the spring were to move, it might have an unfavourable effect on the constancy of the frequency.

20 The arrangement of the stabilisation member permits an adjustment of the frequency of the oscillator that is almost uninfluenced by the residual length of the spring. The distance between the two fork heads is limited even with a large adjusting movement of the adjusting member. The limitation is provided by the dragging connection formed by the driving nose 86 and the banking point 88 or the carrying arm 74. This dragging connection makes sure 25 that the stabilisation member is driven by the adjustment member on setting of the regulating lever 84 when the adjustment member 54 occupies a predetermined position relative to the stabilisation member 56. If the adjustment member 54 is rotated in the direction of the arrow shown in Fig. 4 30 for the purpose of increasing the frequency of the oscillator, the fork head of the adjustment member slides with corresponding friction on the outer coil of the hairspring. The stabilisation member remains at rest 40 until the driving nose 86 bears against its carrying arm 74, and then from this time the two members move together in common relatively to the hairspring.

45 If the frequency of the oscillator is to be reduced, the regulating lever 84 must be rotated in the opposite direction. The stabilisation member 56 will remain at rest until the driving nose 86 bears against the banking point 88 of the stabilisation member (this situation is shown in Fig. 4) and then from this time the two members will move together. The maximum distance 50 between the two fork heads is limited by the driving nose 86 and the carrying arm 74 so that it never becomes so large that when the adjustment member is adjusted in the said opposite direction the spring would buckle between the two fork heads during the initial movement of the adjustment member before it entrains the stabilisation member. The portion of the hairspring kept 60 between the two fork heads is only slightly deformed.

65 In each phase of movement of the ad-

justment member and the stabilisation member, the residual spring portion 58 is kept in position and the outer spring coil is arranged free from side play in the adjustment member.

In the second embodiment of the invention illustrated in Figures 6 to 9, parts of the watch movement resembling in their constructive design the corresponding parts of Figures 1 to 3 are marked with the same reference numbers.

In this second embodiment the balance bridge 100 has a different shape. This balance bridge, at one side, has an arched guide part 102 having an inner concave guide edge 104. The outer limiting edge 106 of guide part 102 is preferably parallel to the inner guide edge 104. The regulating device 108 is adjustable around the centre of the oscillator mass. Analogous to the first embodiment the regulating device 108 includes an adjustment member 110 and a stabilisation member 112.

The adjustment member 110 has a slotted carrying ring 114 and is pivotably positioned on the bearing bushing between the bushing flange 38 and the balance bridge 100. A regulating lever 116 is integral with the carrying ring. A plate-like extension 118 carries at an angular distance from the regulating lever an arm 122 carrying a fork head 120. Extension 118 carries a driving nose 124 at a distance from the said arm 122. The fork head 120 has two fork tines 126 and 128 directed approximately vertically downwards relative to the arm 122, which tines define a first spring passage 130.

The stabilisation member 112 is in the shape of a rectangular plate which is movable by the adjustment member as well as by an arcuate guide 102, see Fig. 8. Plate 112 has a slot 132 in which the arm 122 of the fork head 120 engages. A slot 134 is arranged at its opposite end and the arcuate guide 102 of the balance bridge engages in the slot 134. Approximately in the central part of the plate there extends upwardly (in Fig. 9) from the lower longitudinal edge of the plate a slotted recess 136 forming a second spring passage. At the upper longitudinal edge there is arranged an open recess 138 in which the driving nose 124 engages, with some side play.

As shown in Fig. 8, the fork head 120 is arranged obliquely on the arm 122 i.e. at other than 90° thereto. The fork tine 126 bears against the inner side of the hairspring and the fork tine 128 bears against the outer side of the hairspring which passes through the spring passage 130. The hairspring is drawn through the second spring passage 136 so that (as seen in Fig. 8) the outer, upper

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lateral edge 140 of the recess 136 bears against the inner side of the hairspring and the inner, lower lateral edge 142 of the recess 136 bears against the outer side of the hairspring.

In this second embodiment, the fork head 120 determines the end point of resilience analogous to the fork head 55 of the first embodiment. The stabilisation member 112 ensures that the residual portion of the spring is held and cannot move.

Due to the side play between the driving nose 124 and the lateral walls of the recess 138, the stabilisation member 112 is moved, in either direction, after a predetermined initial movement of the adjustment member 110. The guide edge 104 acts as a cam face which guides the stabilisation member 112 when it is moved by the adjustment member 110, and additional guidance is given by the arm 122 with which the slot 132 is engaged. The hairspring urges the stabilisation member against the edge 104. In every adjusted position of the adjustment member 110 and the stabilisation member 112 the hairspring is kept in position and the residual portion 58 of the spring is stabilised.

WHAT WE CLAIM IS:—

1. A regulator for regulating the frequency of a horological mechanical oscillator, the oscillator comprising an oscillator mass and at least one spring attached at one end to the oscillator mass and at its opposite end to a fixed attachment point, said regulator including an adjusting device and a stabilisation device, said adjusting device including a forked member adjustable along the spring to vary its effective length, said stabilisation device including a member for holding the residual portion of the spring between the point of action of the adjusting member and the attachment point and adjustable along the residual portion of the spring.

2. A regulator in accordance with claim 1, wherein the stabilisation member is arranged so that the residual portion of the spring substantially remains at rest during movement of the oscillator.

3. A regulator in accordance with claim 1 or claim 2, wherein the spring bears against the two members under elastic pressure.

4. A regulator in accordance with any one of claims 1 to 3, wherein the spring is held in a deformed condition by each of the two members.

5. A regulator in accordance with any one of claims 1 to 3, wherein each of the two members has two fork tines that bear against the spring on opposite sides thereof

and at positions spaced longitudinally of the spring.

6. A regulator in accordance with any one of the preceding claims, wherein the stabilisation member is movable relative to the adjustment member within a predetermined limited range.

7. A regulator in accordance with any one of the preceding claims, wherein the two members are coupled by a lost-motion connection.

8. A regulator in accordance with any one of claims 1 to 6, wherein the adjustment member has a driving means that drives the stabilisation member through a lost-motion connection in one or both adjusting directions.

9. A regulator in accordance with any one of the preceding claims, wherein the greatest distance apart to which the two members can move is limited such that the portion of the spring between them is prevented from buckling when the adjustment member is moved relative to and in the direction of the stabilisation member.

10. A regulator in accordance with any one of the preceding claims, wherein the two members are arranged coaxially to one another.

11. A regulator in accordance with any one of the preceding claims, wherein the two members are arranged one upon the other.

12. A regulator in accordance with any one of the preceding claims, wherein the two members are coaxial to the axis of oscillation of the oscillator.

13. A regulator in accordance with any one of claims 1 to 9, wherein the stabilisation member is guided by a cam face of a stationary part.

14. A regulator in accordance with claim 13, wherein the stabilisation member is urged against the cam face by the spring.

15. A regulator in accordance with any one of the preceding claims, wherein the spring is a spiral spring.

16. A regulator for regulating the frequency of a horological mechanical oscillator substantially as hereinbefore described with reference to Figures 1 to 5 or Figures 6 to 9 of the accompanying drawings.

17. A watch having a mechanical oscillator which incorporates the regulator as claimed in any one of the preceding claims.

STEVENS, HEWLETT & PERKINS,
Chartered Patent Agents,
5, Quality Court,
Chancery Lane,
London, W.C.2.
Tel. 01-405 8393.



lateral edge 140 of the recess 136 bears against the inner side of the hairspring and the inner, lower lateral edge 142 of the recess 136 bears against the outer side of the hairspring.

In this second embodiment, the fork head 120 determines the end point of resilience analogous to the fork head 55 of the first embodiment. The stabilisation member 112 ensures that the residual portion of the spring is held and cannot move.

Due to the side play between the driving nose 124 and the lateral walls of the recess 138, the stabilisation member 112 is moved, in either direction, after a predetermined initial movement of the adjustment member 110. The guide edge 104 acts as a cam face which guides the stabilisation member 112 when it is moved by the adjustment member 110, and additional guidance is given by the arm 122 with which the slot 132 is engaged. The hairspring urges the stabilisation member against the edge 104. In every adjusted position of the adjustment member 110 and the stabilisation member 112 the hairspring is kept in position and the residual portion 58 of the spring is stabilised.

WHAT WE CLAIM IS:—

1. A regulator for regulating the frequency of a horological mechanical oscillator, the oscillator comprising an oscillator mass and at least one spring attached at one end to the oscillator mass and at its opposite end to a fixed attachment point, said regulator including an adjusting device and a stabilisation device, said adjusting device including a forked member adjustable along the spring to vary its effective length, said stabilisation device including a member for holding the residual portion of the spring between the point of action of the adjusting member and the attachment point and adjustable along the residual portion of the spring.

2. A regulator in accordance with claim 1, wherein the stabilisation member is arranged so that the residual portion of the spring substantially remains at rest during movement of the oscillator.

3. A regulator in accordance with claim 1 or claim 2, wherein the spring bears against the two members under elastic pressure.

4. A regulator in accordance with any one of claims 1 to 3, wherein the spring is held in a deformed condition by each of the two members.

5. A regulator in accordance with any one of claims 1 to 3, wherein each of the two members has two fork tines that bear against the spring on opposite sides thereof

and at positions spaced longitudinally of the spring.

6. A regulator in accordance with any one of the preceding claims, wherein the stabilisation member is movable relative to the adjustment member within a predetermined limited range.

7. A regulator in accordance with any one of the preceding claims, wherein the two members are coupled by a lost-motion connection.

8. A regulator in accordance with any one of claims 1 to 6, wherein the adjustment member has a driving means that drives the stabilisation member through a lost-motion connection in one or both adjusting directions.

9. A regulator in accordance with any one of the preceding claims, wherein the greatest distance apart to which the two members can move is limited such that the portion of the spring between them is prevented from buckling when the adjustment member is moved relative to and in the direction of the stabilisation member.

10. A regulator in accordance with any one of the preceding claims, wherein the two members are arranged coaxially to one another.

11. A regulator in accordance with any one of the preceding claims, wherein the two members are arranged one upon the other.

12. A regulator in accordance with any one of the preceding claims, wherein the two members are coaxial to the axis of oscillation of the oscillator.

13. A regulator in accordance with any one of claims 1 to 9, wherein the stabilisation member is guided by a cam face of a stationary part.

14. A regulator in accordance with claim 13, wherein the stabilisation member is urged against the cam face by the spring.

15. A regulator in accordance with any one of the preceding claims, wherein the spring is a spiral spring.

16. A regulator for regulating the frequency of a horological mechanical oscillator substantially as hereinbefore described with reference to Figures 1 to 5 or Figures 6 to 9 of the accompanying drawings.

17. A watch having a mechanical oscillator which incorporates the regulator as claimed in any one of the preceding claims.

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