

PATENT SPECIFICATION (11)

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(54) DETENT APPARATUS E.G. FOR USE IN AN ELECTRONIC TIMEPIECE

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese company of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, 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:—

10 This invention concerns detent apparatus, e.g. for use in an electronic timepiece.

According to the present invention, there is provided detent apparatus comprising a toothed wheel which is adapted to be rotated in a predetermined angular direction, and a jewel which engages the toothed wheel to prevent reverse rotation thereof, the jewel being mounted at an end portion of a spring which urges the jewel into engagement with the toothed wheel, the opposite end portion of the spring being carried by a rotatable pin rotation of which adjusts the position of the jewel substantially radially of the toothed wheel.

25 The rotatable pin is preferably rotatably mounted on a pivotable member pivotal movement of which adjusts the position of the jewel substantially tangentially of the toothed wheel.

30 The invention also includes apparatus as set forth above in combination with drive means for rotating the toothed wheel in the said predetermined angular direction. The said drive means may comprise a stepping motor.

35 Additionally, the invention comprises an electronic timepiece provided with apparatus as set forth above.

40 The invention is illustrated, merely by way of example, in the accompanying drawings, in which:—

Figure 1 is a broken-away plan view of a part of an electronic timepiece provided with detent apparatus known in Japan.

45 Figure 2 illustrates the voltage waveform supplied to a stepping motor forming part of the structure shown in Figure 1, and

Figure 3 is a broken-away plan view of

an electronic timepiece provided with detent apparatus in accordance with the present invention. 50

In Figure 1 there is shown a part of a timepiece movement for an electronic timepiece which is known in Japan. The timepiece movement 10 comprises a stepping motor having a six pole rotor 11 provided with alternate North and South poles. The rotor 11 is mounted between stator members 12, 13 which are respectively provided with North and South poles. 55

The rotor 11 is mounted on a shaft which carries a pinion 14, the latter meshing with a second wheel 15. 60

The second wheel 15 is provided with teeth 20 which are engaged by a V-shaped end portion 21 of a spring 22. In order to simplify the drawing, only a few of the teeth 20, which extend right around the second wheel 15, are shown. The end portion of the spring 22 which is remote from the V-shaped portion 21 is anchored securely in a fixing pin 23 which is itself secured to an arm 24 of a lever 25. The lever 25 is pivotable through a small angle about a pivot pin 26, the lever 25 being secured to a base plate 27 (in which the rotor 11 is also mounted) by means of a screw 30 which permits the said pivotal movement of the lever 25. The pin 26 is preferably arranged near to the straight line 18 which passes through the centre of the second wheel 15 and through the region where the spring 22 contacts the second wheel 15. A pin 31 which is mounted in the plate 27 has an eccentric portion 32 which engages a surface 33 of the lever 25 so that rotation of the eccentric portion 32 causes pivotal movement of the lever 25 about the pivot 26. 65 70 75 80

By positioning the stator portion 13 eccentrically of the rotor 11, and in the direction of an arrow 34 the relative position of the rotor 11 and the stator 12 will be magnetically the same as shown in Figure 1, and the rotor 11 will be rotated in the direction of an arrow 35. Thus rotation 90 95

[Price 25p]

Price 75p

will be effected of the second wheel 15 in the direction of an arrow 36.

The stepping motor divides and synchronises an electric signal whose time standard is determined by a crystal oscillator or tuning fork (not shown). The waveform of the said electric signal is illustrated in Figure 2 and, as will be seen, this waveform is provided with pulses t which are separated from each other by one second in time, E being the driving voltage. When the stator 12 is magnetised as shown in Figure 1, electric current flowing to a driving coil (not shown) will cause the rotor 11 to advance by one pitch, i.e. one sixth of a rotation, and in the direction of the arrow 35. The position of the respective magnetic pole of the rotor 11 after this rotational movement will be reversed with respect to its North and South poles as compared with the position prior to the rotational movement, but the subsequent driving pulse will also provide a reversed polarity, so that the rotor 11 always rotates in the same direction. The pulse width t of the driving voltage E depends upon the length of time which the rotor 11 takes to rotate by one pole pitch. However, when the rotor 11 rotates by one pole pitch and is in its rest position, vibration of the rotor 11 will occur about the centre of its rest position, by reason of the relationship between the torque arising from the inertia of the moving rotor, and the attracting force exercised by the stator. As a result, it is possible for the rotor 11 to move in a direction opposite to the arrow 35, and it is also possible for such vibration to cause the rotor to advance by a two pitch instead of a one pitch movement. It is for this reason that the index spring 22 is provided in order to try to eliminate such vibration of the rotor and to prevent its mis-operation.

When, moreover, the construction shown in Figure 1 is provided in a watch having a calendar mechanism, a load torque is applied in the reverse direction to the direction in which the gear train is rotated. Consequently, when this load torque is added to the above-mentioned vibration of the rotor 11 in the reverse rotational direction, the second wheel 15 is liable to push the index spring 22 to a position where the reverse rotation can occur.

Furthermore, in the construction shown in Figure 1, although it is possible to adjust the position of the V-shaped end portion 21 tangentially of the second wheel 15 by rotation of the eccentric portion 32, it is not possible to adjust the position of the V-shaped end portion 21 radially of the second wheel 15 except by bending the index spring 22 at its root. However, such bending will either mean that the pressure with which the V-shaped end portion 21 is urged against

the teeth 20 is reduced, with the result that its detent operation and hence the indexing is made less effective, or it will mean that the said pressure is increased so that frictional losses are also increased.

The construction shown in Figure 3, which is in accordance with the present invention, is generally similar to that of Figure 1, and will not therefore be described in detail, like reference numerals indicating like parts. However, in the construction of Figure 3, the spring 22, instead of being provided with a V-shaped end portion 21, is provided with a pallet jewel 40 having an oblique face 41 which engages the teeth 20 of the second wheel 15. This enables the teeth 20 to ride easily over the surface 41 when the second wheel 15 rotates in the direction of the arrow 36. Reverse rotation of the second wheel 15, however, is prevented by engagement between the respective tooth 20 and a surface 42 of the pallet jewel 40 which extends radially of the second wheel 15. If such reverse rotation starts to occur, there will merely be very temporary radially inward bending of the spring 22, while the pallet jewel 40 will not be forced radially outwardly.

Moreover, the end of the spring 22 remote from the pallet jewel 40, instead of being anchored in a fixed position at the end of the arm 24, is carried by a rotatable pin 43 having an arm 44 to permit rotation thereof. Rotation of the arm 44 therefore moves the pallet jewel 40 substantially radially to the second wheel 15, and consequently enables one to adjust the degree to which the pallet jewel 40 is applied against the teeth 20.

WHAT WE CLAIM IS:—

1. Detent apparatus comprising a toothed wheel which is adapted to be rotated in a predetermined angular direction, and a jewel which engages the toothed wheel to prevent reverse rotation thereof, the jewel being mounted at an end portion of a spring which urges the jewel into engagement with the toothed wheel, the opposite end portion of the spring being carried by a rotatable pin rotation of which adjusts the position of the jewel substantially radially of the toothed wheel.

2. Apparatus as claimed in claim 1 in which the rotatable pin is rotatably mounted on a pivotable member pivotal movement of which adjusts the position of the jewel substantially tangentially of the toothed wheel.

3. Apparatus as claimed in any preceding claim in combination with drive means for rotating the toothed wheel in the said predetermined angular direction.

4. Apparatus as claimed in claim 3 in which the said drive means comprises a stepping motor.

5. Detent apparatus substantially as 130

will be effected of the second wheel 15 in the direction of an arrow 36.

The stepping motor divides and synchronises an electric signal whose time standard is determined by a crystal oscillator or tuning fork (not shown). The waveform of the said electric signal is illustrated in Figure 2 and, as will be seen, this waveform is provided with pulses t which are separated from each other by one second in time, E being the driving voltage. When the stator 12 is magnetised as shown in Figure 1, electric current flowing to a driving coil (not shown) will cause the rotor 11 to advance by one pitch, i.e. one sixth of a rotation, and in the direction of the arrow 35. The position of the respective magnetic pole of the rotor 11 after this rotational movement will be reversed with respect to its North and South poles as compared with the position prior to the rotational movement, but the subsequent driving pulse will also provide a reversed polarity, so that the rotor 11 always rotates in the same direction. The pulse width t of the driving voltage E depends upon the length of time which the rotor 11 takes to rotate by one pole pitch. However, when the rotor 11 rotates by one pole pitch and is in its rest position, vibration of the rotor 11 will occur about the centre of its rest position, by reason of the relationship between the torque arising from the inertia of the moving rotor, and the attracting force exercised by the stator. As a result, it is possible for the rotor 11 to move in a direction opposite to the arrow 35, and it is also possible for such vibration to cause the rotor to advance by a two pitch instead of a one pitch movement. It is for this reason that the index spring 22 is provided in order to try to eliminate such vibration of the rotor and to prevent its mis-operation.

When, moreover, the construction shown in Figure 1 is provided in a watch having a calendar mechanism, a load torque is applied in the reverse direction to the direction in which the gear train is rotated. Consequently, when this load torque is added to the above-mentioned vibration of the rotor 11 in the reverse rotational direction, the second wheel 15 is liable to push the index spring 22 to a position where the reverse rotation can occur.

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the teeth 20 is reduced, with the result that its detent operation and hence the indexing is made less effective, or it will mean that the said pressure is increased so that frictional losses are also increased.

The construction shown in Figure 3, which is in accordance with the present invention, is generally similar to that of Figure 1, and will not therefore be described in detail, like reference numerals indicating like parts. However, in the construction of Figure 3, the spring 22, instead of being provided with a V-shaped end portion 21, is provided with a pallet jewel 40 having an oblique face 41 which engages the teeth 20 of the second wheel 15. This enables the teeth 20 to ride easily over the surface 41 when the second wheel 15 rotates in the direction of the arrow 36. Reverse rotation of the second wheel 15, however, is prevented by engagement between the respective tooth 20 and a surface 42 of the pallet jewel 40 which extends radially of the second wheel 15. If such reverse rotation starts to occur, there will merely be very temporary radially inward bending of the spring 22, while the pallet jewel 40 will not be forced radially outwardly.

Moreover, the end of the spring 22 remote from the pallet jewel 40, instead of being anchored in a fixed position at the end of the arm 24, is carried by a rotatable pin 43 having an arm 44 to permit rotation thereof. Rotation of the arm 44 therefore moves the pallet jewel 40 substantially radially to the second wheel 15, and consequently enables one to adjust the degree to which the pallet jewel 40 is applied against the teeth 20.

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2. Apparatus as claimed in claim 1 in which the rotatable pin is rotatably mounted on a pivotable member pivotal movement of which adjusts the position of the jewel substantially tangentially of the toothed wheel.

3. Apparatus as claimed in any preceding claim in combination with drive means for rotating the toothed wheel in the said predetermined angular direction.

4. Apparatus as claimed in claim 3 in which the said drive means comprises a stepping motor.

5. Detent apparatus substantially as



hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings.

6. An electronic timepiece provided with
5 apparatus as claimed in claim 4 or 5.

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