

WM/TIM-37
Singapore 10

PATENT SPECIFICATION

DRAWINGS ATTACHED

1099.897



Date of Application and filing Complete Specification: Sept. 7, 1966.

No. 40058/66.

Application made in Germany (No. U12070 IXb/83a) on Sept. 29, 1965.

Complete Specification Published: Jan. 17, 1968.

© Crown Copyright 1968.

Index at acceptance:—G3 T(A4D, A6B)

Int. Cl.:—G 04 b 15/00

COMPLETE SPECIFICATION

Seconds Hand Drive Train Arrangement

We, THE UNITED STATES TIME CORPORATION, a Corporation organised under the laws of the State of Connecticut, 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 timekeeping instruments and more particularly to a mechanism to actuate the seconds hand of a timekeeping instrument so that it moves in rapid starts and stops, i.e., in a jump-like fashion.

There has been for many years a demand for watches, for example, whose seconds hand, instead of moving generally smoothly around the dial, is progressed in jumps. Such jumps are step-by-step motions for each time the seconds hand moves one second, i.e., six degrees on the dial.

The requirements on the mechanism are that it changes the steady rotational movement of the index wheel, which is the wheel receiving the watch's driving power, and convert it into a jerky motion of a short uniform length.

As the jump motion is required sixty times a minute and the watch should run for years, it is essential that the mechanism be sturdy and not subject to rapid wear. If a mechanism is simple it is less likely to fail in service than one that is complex. So the jump seconds mechanism should be simple. Such simplicity provides savings in the cost of manufacture and in repair.

Various mechanisms have been proposed and utilized for this purpose, but some of them are relatively fragile or costly. They must be adjusted as they are directly dependent upon the frequency of the balance wheel. In addition, as these mechanisms drive the seconds wheel directly, the movement of the seconds wheel is affected by amplitude variations of the balance wheel.

It is the objective of the present invention to provide a jump seconds hand mechanism for a timekeeping instrument, which mechanism is relatively sturdy, simple, inexpensive and long wearing; which operates with any balance wheel frequency, and which is independent of variations in balance wheel amplitude.

In accordance with the present invention there is provided in a timekeeping instrument having a seconds hand, a motive means and a frame plate, a drive train to said seconds hand including an index wheel driven by said motive means,

an elongated helical gear connected to said index wheel and fixedly mounted on a staff, said gear having an initial axial setting position and an axial position in which it effects an indexing motion,

means to journal said staff on the plate so that it is rotatable and movable axially,

a seconds wheel adapted to be driven by said elongated gear and connected to said seconds hand,

means to journal said seconds wheel or said frame plate,

means to move said elongated gear axially from the initial setting position into rapid indexing motion of said elongated gear, and

means to control said axial motion so that it is operative once every second.

The invention may suitably be embodied in a timepiece which includes a balance wheel or other regulator, such as a vibratory member, which is driven by well-known methods, for example, by an electrical battery or a main spring. The balance wheel oscillates a forked lever having elongated driving pins. The pins act on the teeth of an index wheel (escape wheel) to rotate the wheel. The index wheel is fixed to a shaft which is movable axially and is rotatable. This shaft is depressed against a spring by a camming arm which acts against the spokes of the index wheel. An indexing gear in the form of an elongated helical gear,

is mounted on the same shaft as the index wheel. The teeth of the helical gear are in mesh with the seconds wheel. At the end of its camming action, the index wheel is suddenly released and its shaft is pushed quickly upward by the spring. This motion causes the helical gear to quickly turn the seconds wheel, in a jerky fashion, the amount required for the seconds hand to move one second. The helical gear does not rotate the seconds wheel during its axial depression.

The motive power to shift the seconds wheel is not produced, as in other known shifting arrangements, by a direct drive, but exclusively by the intermediate drive train of the present invention. This has the advantage of providing a constant torque transmission from the balance wheel to the index wheel. The one-second step of the seconds wheel, when it is caused by the helical gear, does not reflect amplitude variations of the balance wheel.

The invention will be further explained in the following description of a preferred embodiment, reference being made to the accompanying drawings in which:—

Fig. 1 is a diagrammatic perspective view of the parts forming the indexing arrangement of a wrist watch movement according to the present invention;

Fig. 2 is a cross-sectional view of the parts shown in Fig. 1, in which the indexing member, a helical gear, is in its initial setting;

Fig. 3 is a cross-sectional view in the same manner as Fig. 2, in which the indexing member is in its indexing position; and

Fig. 4 is a partial top view of the arrangement according to Figs. 1 to 3.

The drawings show a part of the gear train of a wrist watch movement. The movement parts are located between an upper frame plate 10 and a lower frame plate 12 on which the necessary bridges are arranged. The seconds wheel 14 (fourth wheel) is carried on a staff 20 on which the seconds hand 22 is fixed. The axle 20 is pivotable and is carried by bridges 16 and 18, see Fig. 1. The seconds wheel 14 is driven by an indexing arrangement, designated as a unit by 24. The drive to the seconds wheel 14 is in such a manner that the seconds hand 22 will be jerkily indexed every second for one indexing step. This type of movement is sometimes called a "jump seconds" movement.

The indexing arrangement includes an indexing member, preferably in the form of a helical gear 26 having teeth 28 which slant relative to the axis of the gear. The teeth 28 engage in the tooth spaces of the teeth 30 of the seconds wheel 14. The helical gear 26 is fixed on a carrying axle 32. Axle 32 is journaled with pivots 34 and 36 between bridges 36 and 40 on the lower and upper frame plates. The helical gear 26 is solidly fixed on its carrying axle 32. The carrying

axle 32 is axially slidable in the bearings of the bridges 38 and 40.

A spring blade 42 acts as a control device. The spring blade 42 is fixed on the lower frame plate 12 and tries, by pushing on the bearing pivot 36 of the carrying axle 32, to raise the helical gear 26 into its final indexing position, shown in Fig. 3.

The carrying axle 32 is driven directly in the arrangement described by a lever driving means 44 which includes a lever staff 46 which carries an oscillatory lever 48 having two arms 50 and 56. The lever arm 50, having a forked end portion, co-operates with banking pins 52 and 54 to restrict the amplitude of the lever. The other lever arm 56 carries elongated index pins 62 and 64. The pins 62 and 64 co-operate with teeth 58 of an index wheel 60 (escape wheel) on axle 32. The two-armed lever 48 is driven by an indexing pin 68 fixed on a roller 66. The roller 66 is fixed, in a known manner, on a balance staff 70 which is oscillated by a balance wheel (not shown). The balance wheel may be oscillated by an electrical or mechanical drive system (not shown). The index wheel could be driven in any other desired manner, e.g., by a supplementary wheel. An electronically maintained mechanical resonator (vibrator) may be used to drive the roller 66 or to drive a wheel meshing with a wheel on the staff 70.

The jumping of the seconds wheel 14 (and of the hand 22) occurs because the helical gear 26 is rapidly translated from its lower initial setting shown in Fig. 2 into its indexing position shown in Fig. 3. This indexing motion is due to the release of the spring blade 42, which acts on the carrying axle 32 to shift the axle 32 axially upwardly causing the helical gear 26, having the flanks of its teeth 38 engaged with teeth 30 of the seconds wheel 14, to hit on the tooth backs of wheel 14. The seconds wheel 14 is thereby rotated for a one-second jump step. A control arrangement 72 times the release of spring 42. The control arrangement 72 illustrated includes the index wheel 60 which has a hub 74 fixed on the carrying axle 32. This hub 14 is connected with the wheel rim 76 by spokes 78.

A curved part 80 causes the downwards axial movement of the carrying axle 32 and the helical gear 26 to the initial setting. This curved part 80 is a lancing from the section 82 of the upper frame plate 10. The lower surface of the curved part 80 forms an end curved face 86 (see Figs. 2 and 3). This curved face 86 penetrates the arcuate slots 84 located between the spokes 78 of the index wheel 60, when the index wheel is in its indexing (jump) position. The spokes 78 are held and cammed against face 86 by the action of the spring blade 42 during the time the index wheel is being rotated step by step by the lever 48. The leading edges of the spokes 78

act as trip edges 87, and engage the curved face 86 of the curved part 80.

The mode of operation of the control arrangement 72 is as follows: In order to obtain the one-second steps of the seconds wheel 14, the helical gear 26 must perform one indexing step every second from its initial setting to its indexing position. This requirement provides the dimensions of the spokes 78. The index wheel must make one revolution in an integral number of seconds, for example, 1, 2, 3 or 4. The length of the slots 84 formed by the spokes 78 is related to this integral number of seconds. The construction illustrated is laid out in such a manner that the index wheel 60 performs a complete revolution in four seconds. Therefore the spokes 78 have an angular distance from each other such that, during the four seconds needed for a complete revolution of the index wheel, the helical gear shifts four times. Therefore, the spokes 78 are arranged into two pairs, each spoke being displaced 90° relative to each other.

In Figs. 1 and 2 the helical gear 26 is located in its lowest position, in its initial setting with the spring 42 under tension. The helical gear 26 is forced downward into this position by the action of the curved part 80 on the spokes 78. The part 80 penetrates through the arcuate slots 84 and, with its curved face 86, co-operates with one of the spokes 78. The axial movement of the carrying axle 22 and the helical gear 26 occurs automatically downwards to the position shown in Figs. 1 and 2 as the index wheel is rotated. The axial distance moved is preferably from one to one-and-a-half times as long as the sixtieth part of the circumference of the seconds wheel. The axial distance moved is determined by the curvature of the surface 86 of the curved part 80.

As soon as the end piece or tip of the curved part 80 is released by one of the spokes 78 held against this curved part by the force of the spring blade 42, the carrying axle 32 and the helical gear 26 move within a fraction of a second axially upwards into the indexing position, ending in the position shown in Fig. 3. The curved part 80 will penetrate in the next arcuate slot 84 of the index wheel and the following spoke 78 will ride against the curved face 86 of the curved part. The helical gear will be rotated during the following 90° rotation of the index wheel into its axially depressed initial setting so that the same movement can be repeated.

It will be appreciated that references in this specification to upward and downward movement are related to the attitude of the device as shown in the accompanying drawings and are not absolute.

The sloping face of the indexing member (helical gear) co-operates with the seconds wheel carrying a hand. In the present case, the slope of the teeth of the helical gear must

have a dimension such that during the setback of the helical gear to its initial setting (during which it rotates and its teeth are engaged with the seconds wheel) the helical gear does not move the teeth of the seconds wheel beyond the regular backlash.

Modifications may be made in the present invention within the scope of the appended claims. For example, the means to move the staff carrying the helical gear may be on the helical gear in the form of raised portions, instead of on the index wheel. Such raised portions would cam against a fixed arm.

WHAT WE CLAIM IS:—

1. In a timekeeping instrument having a seconds hand, a motive means and a frame plate, a drive train to said seconds hand including
 - an index wheel driven by said motive means,
 - an elongated helical gear connected to said index wheel and fixedly mounted on a staff, said gear having an initial axial setting position and an axial position in which it effects an indexing motion,
 - means to journal said staff on the plate so that it is rotatable and movable axially,
 - a seconds wheel adapted to be driven by said elongated gear and connected to said seconds hand,
 - means to journal said seconds wheel on said frame plate,
 - means to move said elongated gear axially from the initial setting position into rapid indexing motion of said elongated gear, and
 - means to control said axial motion so that it is operative once every second.
2. A timekeeping instrument in accordance with claim 1, in which the index wheel is arranged on the staff carrying the helical gear.
3. A timekeeping instrument in accordance with claim 1 or claim 2, in which said control means is on the gear.
4. A timekeeping instrument in accordance with claim 1 or claim 2, in which the control means includes a fixed camming arm attached to the frame plate.
5. A timekeeping instrument in accordance with claim 4, in which the index wheel has camming members which act against said fixed arm.
6. A timekeeping instrument in accordance with claim 1 or claim 2, in which said control means is on the index wheel.
7. A timekeeping instrument according to claim 5, in which the camming arm comprises a stationary curved part fixed to or integral with the frame plate and co-operates for the axial shifting of the staff with the camming members provided on the index wheel.
8. A timekeeping instrument in accordance with claim 7, in which the camming members are arranged in pairs on a circular path on the index wheel.
9. A timekeeping instrument in accordance with claim 8, in which the camming members



act as trip edges 87, and engage the curved face 86 of the curved part 80.

The mode of operation of the control arrangement 72 is as follows: In order to obtain the one-second steps of the seconds wheel 14, the helical gear 26 must perform one indexing step every second from its initial setting to its indexing position. This requirement provides the dimensions of the spokes 78. The index wheel must make one revolution in an integral number of seconds, for example, 1, 2, 3 or 4. The length of the slots 84 formed by the spokes 78 is related to this integral number of seconds. The construction illustrated is laid out in such a manner that the index wheel 60 performs a complete revolution in four seconds. Therefore the spokes 78 have an angular distance from each other such that, during the four seconds needed for a complete revolution of the index wheel, the helical gear shifts four times. Therefore, the spokes 78 are arranged into two pairs, each spoke being displaced 90° relative to each other.

In Figs. 1 and 2 the helical gear 26 is located in its lowest position, in its initial setting with the spring 42 under tension. The helical gear 26 is forced downward into this position by the action of the curved part 80 on the spokes 78. The part 80 penetrates through the arcuate slots 84 and, with its curved face 86, co-operates with one of the spokes 78. The axial movement of the carrying axle 22 and the helical gear 26 occurs automatically downwards to the position shown in Figs. 1 and 2 as the index wheel is rotated. The axial distance moved is preferably from one to one-and-a-half times as long as the sixtieth part of the circumference of the seconds wheel. The axial distance moved is determined by the curvature of the surface 86 of the curved part 80.

As soon as the end piece or tip of the curved part 80 is released by one of the spokes 78 held against this curved part by the force of the spring blade 42, the carrying axle 32 and the helical gear 26 move within a fraction of a second axially upwards into the indexing position, ending in the position shown in Fig. 3. The curved part 80 will penetrate in the next arcuate slot 84 of the index wheel and the following spoke 78 will ride against the curved face 86 of the curved part. The helical gear will be rotated during the following 90° rotation of the index wheel into its axially depressed initial setting so that the same movement can be repeated.

It will be appreciated that references in this specification to upward and downward movement are related to the attitude of the device as shown in the accompanying drawings and are not absolute.

The sloping face of the indexing member (helical gear) co-operates with the seconds wheel carrying a hand. In the present case, the slope of the teeth of the helical gear must

have a dimension such that during the setback of the helical gear to its initial setting (during which it rotates and its teeth are engaged with the seconds wheel) the helical gear does not move the teeth of the seconds wheel beyond the regular backlash.

Modifications may be made in the present invention within the scope of the appended claims. For example, the means to move the staff carrying the helical gear may be on the helical gear in the form of raised portions, instead of on the index wheel. Such raised portions would cam against a fixed arm.

WHAT WE CLAIM IS:—

1. In a timekeeping instrument having a seconds hand, a motive means and a frame plate, a drive train to said seconds hand including

an index wheel driven by said motive means, an elongated helical gear connected to said index wheel and fixedly mounted on a staff, said gear having an initial axial setting position and an axial position in which it effects an indexing motion,

means to journal said staff on the plate so that it is rotatable and movable axially,

a seconds wheel adapted to be driven by said elongated gear and connected to said seconds hand,

means to journal said seconds wheel on said frame plate,

means to move said elongated gear axially from the initial setting position into rapid indexing motion of said elongated gear, and

means to control said axial motion so that it is operative once every second.

2. A timekeeping instrument in accordance with claim 1, in which the index wheel is arranged on the staff carrying the helical gear.

3. A timekeeping instrument in accordance with claim 1 or claim 2, in which said control means is on the gear.

4. A timekeeping instrument in accordance with claim 1 or claim 2, in which the control means includes a fixed camming arm attached to the frame plate.

5. A timekeeping instrument in accordance with claim 4, in which the index wheel has camming members which act against said fixed arm.

6. A timekeeping instrument in accordance with claim 1 or claim 2, in which said control means is on the index wheel.

7. A timekeeping instrument according to claim 5, in which the camming arm comprises a stationary curved part fixed to or integral with the frame plate and co-operates for the axial shifting of the staff with the camming members provided on the index wheel.

8. A timekeeping instrument in accordance with claim 7, in which the camming members are arranged in pairs on a circular path on the index wheel.

9. A timekeeping instrument in accordance with claim 8, in which the camming members



are formed by spokes which connect the hub and the rim of the index wheel with each other.

5 10. A timekeeping instrument in accordance with claim 9, in which, as seen in the sense of the rotation of the index wheel, the leading edges of the spokes serve as trip edges for the stationary curved part.

10 11. A timekeeping instrument in accordance with any one of the preceding claims, in which the means to move the staff axially is a spring.

12. A timekeeping instrument in accordance

with claim 11, in which the spring is a spring blade which contacts a bearing pivot of the staff.

13. In or for a timekeeping instrument, a seconds hand drive train constructed and arranged to operate substantially as hereinbefore described with reference to the accompanying drawings.

STEVENS, LANGNER,
PARRY & ROLLINSON,
Chartered Patent Agents,
Agents for the Applicants.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.
—1968. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.