PATENT SPECIFICATION

DRAWINGS ATTACHED

819,364

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COMPLETE SPECIFICATION

Improvements in or relating to Timepieces

We, BULOVA WATCH COMPANY, INC., of 75—20 Astoria Boulevard, Flushing 70, New York, United States of America, a corporation organised under the laws of the State of New York, 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 a time-piece.

More particularly, the present invention relates to a time-piece incorporating a motion transformer capable of transforming the oscillations of a vibrator into rotary movement.

It is an object of the present invention to provide a time-piece which incorporates an improved motion transformer adapted to transform the oscillations of a vibrator into the rotary movement of the hands of the time-piece.

According to the present invention there is provided a time-piece having a time piece mechanism including a ratchet wheel, a pawl biassed against said ratchet wheel so as to permit continuous rotation of said ratchet wheel in only one direction, a vibrator for driving said ratchet wheel in said one direction through an intermediate friction drive mechanism, said mechanism comprising a driving member rigidly coupled to said ordinates and arranged to bear directly on said ratchet wheel or on another wheel rigidly secured thereto so as frictionally to drive said ratchet wheel in said one direction upon vibration of said vibrator.

For a better understanding of the invention and to show how the same may be carried into effect reference will now be made to the accompanying drawings in which: —

Figure 1 is a fragmentary diagrammatic view of a motion transformer mechanism designed to be incorporated in a time-piece in accordance with the invention; and

Figure 2 is a similar view of a further form of motion transformer mechanism.

Referring to the drawings, there are here illustrated on an enlarged scale, different embodiments of motion transformer mechanisms adapted to be incorporated in an electric time-piece of the kind which forms the subject of our Patent No. 761,609. In both the embodiments driving means are provided which are connected to a vibrator for movement therewith and which frictionally engage rotary means that serve to drive the time-piece at a rate directly proportional to the speed of rotation of such rotary means. Additionally, suitable means are provided for limiting the rotary means to continuous rotation in one direction.

Referring to Figure 1, a vibrator constituted by a tuning fork has a pair of tines 603 and 604 carrying a magnetic drum 606 and a balance weight 607, respectively, the latter carrying an abutment element 607b the free end of which is spaced a distance *s* from the drum 606 when the tines are at rest. The tine 604 also carries a driving means composed of a leaf spring 620 firmly secured at one end to the tine 604 and a friction element 620a carried by the leaf spring 620 at its free end. The friction element 620a may be made of a suitable synthetic material or of a precious or semi-precious stone, as, for example, ruby or sapphire, and is adapted to engage the crests of the teeth of a ratchet wheel 621 which is rotatably mounted at 621a and serves to drive the time-piece mechanism of the time-piece. The crests constitute a discontinuous outer peripheral friction surface so that when the driving means is reciprocated in a direction T tangential to the ratchet wheel at the point of engagement between the friction element 620a and the ratchet wheel, the ratchet wheel is oscillated about its turning axis 621a. Thus, the ratchet wheel is rotated in a counter-clockwise direction, shown by arrow 640, when the driv-

[P

ing means moves leftwardly, as viewed in Figure 14, whereas the ratchet wheel is rotated in a clockwise direction, shown by arrow 640a, when the driving means moves rightwardly.

A pawl means is provided for limiting the ratchet wheel 621 to continuous rotation in the direction of the arrow 640. The pawl means includes a leaf spring 630 firmly secured at one end to the time-piece base plate 601 and a pawl element 630a carried by the leaf spring 630 at its free end.

With the pitch of the ratchet teeth being indicated at P, it will be understood that the pawl means prevents rotation of the ratchet wheel 621, in the direction of the arrow 640a, an angular distance exceeding an angular distance corresponding to the pitch P, so that continuous rotation of the ratchet wheel is limited to rotation in the direction of the arrow 640. It will also be understood that in order for each oscillation of the tine 604 to be accompanied by angular displacement of the ratchet wheel a distance corresponding to the pitch P, the length of the stroke of reciprocation of the driving means should be not less than P and not greater than 2P.

As set forth above, the stroke length of the driving means is a function of or dependent upon the amplitude of oscillation of the tines of the vibrator, so that the tines will have to oscillate with a certain minimum amplitude to cause the driving means to reciprocate with a stroke length at least equal to P. Electrical means such as those referred to above are capable of oscillating the tine 604 at least such minimum amplitude. Furthermore, the distance s is so selected that the maximum amplitude of oscillation of the tines is one at which the stroke length of the driving means does not exceed 2P. The abutment element 607b serves mainly to prevent excessive oscillation of the tines in the event the time-piece is exposed to shocks.

In practice, the electrical means are so constructed as to oscillate the tines with such an amplitude that the driving means reciprocates with a stroke length equal to approximately 1.5P. It will be understood from the above that the pawl means will, during successive reciprocations of the driving means, be engaged by successive ratchet teeth.

In this way, each oscillation of the tines first displaces the ratchet wheel 621, in the direction of the arrow 640, an angular distance corresponding to approximately 1.5P and thereafter, in the direction of the arrow 640a, an angular distance corresponding to approximately 0.5P. The net or effective displacement of the ratchet wheel during each oscillation of the tines is therefore an angular distance corresponding to exactly 1.0P in the direction of the arrow 640, so that the time-piece mechanism is driven at a rate directly proportional to the frequency of oscillation of the vibrator. Since the same has an extremely high degree of constancy, the time-piece mechanism is driven very accurately.

In order to insure proper operation, the natural frequency of the driving means is considerably greater than that of the vibrator. In practice, the natural frequency of the leaf spring 620 and the friction element 620a should be at least twice as great as that of the tines of the vibrator.

Referring to Figure 2, the tuning fork has a pair of tines 703 and 704 carrying a magnetic drum 706 and a balance weight 707, respectively. The balance weight carries an abutment element 707b the free end of which is spaced a distance s^1 from the drum 706 when the tines are at rest. The tine 704 further carries a driving means constituted by a leaf spring 720 firmly secured at one end to the tine 704. The free end of the leaf spring 720 is adapted frictionally to engage the outer peripheral friction surface 721b^1 of a friction wheel 721b which, together with a ratchet wheel 721, forms a rotary means for driving the time-piece mechanism, the rotary means being turnably mounted on the base plate of the time-piece at 721a. A pawl means is provided for limiting the rotary means to continuous rotation in the direction of the arrow 740. The pawl means includes a leaf spring 730 firmly secured at one end to the base plate 601 and pawl element 730a carried by the leaf spring 730 at its free end.

The operation of the device is identical to that of the embodiment illustrated in Figure 1. It will be understood, however, that the selection of the distance s^1 will be influenced by the ratio r_1/r_2^1 with r_1 being the radius of the friction wheel 721b and r_2 being the radius of the ratchet wheel 721.

While the motion transformers illustrated in Figures 1 and 2 have been described as incorporating a tuning fork, a magnetic drum, a balance weight and an abutment element it will be understood that any one of these motion transformers may incorporate any suitably shaped vibrator. Similarly, either of the motion transformers shown in Figures 1 and 2 may be used in conjunction with a tuning-fork type vibrator each tine of which carries a magnetic drum, rather than a tuning-fork vibrator wherein one tine carries a magnetic drum and the other tine carries a balance weight. Also, the abutment means carried by the tines may include one or two abutment elements, or be otherwise suitably shaped.

WHAT WE CLAIM IS:—

1. A time-piece having a time piece mechanism including a ratchet wheel, a pawl biassed against said ratchet wheel so as to permit continuous rotation of said ratchet wheel in only one direction, a vibrator for driving said ratchet wheel in said one direction through an intermediate friction drive mechanism, said mechanism comprising a driving member rigidly coupled to said vibrator and arranged to bear

directly on said ratchet wheel or an another wheel rigidly secured thereto so as frictionally to drive said ratchet wheel in said one direction upon vibration of said vibrator.

2. A time-piece according to Claim 1, wherein the vibrator is of the tuning fork type.

3. A time-piece according to Claim 1 or 2, wherein the driving member frictionally engages the ratchet wheel with a force sufficiently great to cause the ratchet wheel to be rotated in the said one direction during reciprocation of the driving member in a first direction, said wheel being braked by said pawl during reciprocation of the driving member in a second and opposite direction.

4. A time-piece according to Claim 3, wherein said driving member has a natural frequency of oscillation which is greater than and preferably at least twice the frequency of oscillation of the vibrator.

5. A time-piece according to Claim 4, wherein the crests of the ratchet teeth of the ratchet wheel constitute an outer peripheral friction surface which is engaged by the driving member while the same reciprocates during oscillation of the vibrator.

6. A time-piece according to any one of Claims 3, 4 or 5, wherein the driving member comprises an elongated leaf spring or the like one end of which is connected to the vibrator, the opposite end portion of the leaf spring, either directly or by the intermediary of a suitable engaging element, as, for example, a ruby or sapphire leaf or the like, being in frictional engagement with the ratchet wheel or said other wheel.

7. A time-piece according to any one of the preceding claims, wherein electrically actuable means are provided for actuating said vibrator.

8. A time-piece having a time-piece mechanism, substantially as hereinbefore described with reference to either of the accompanying drawings.

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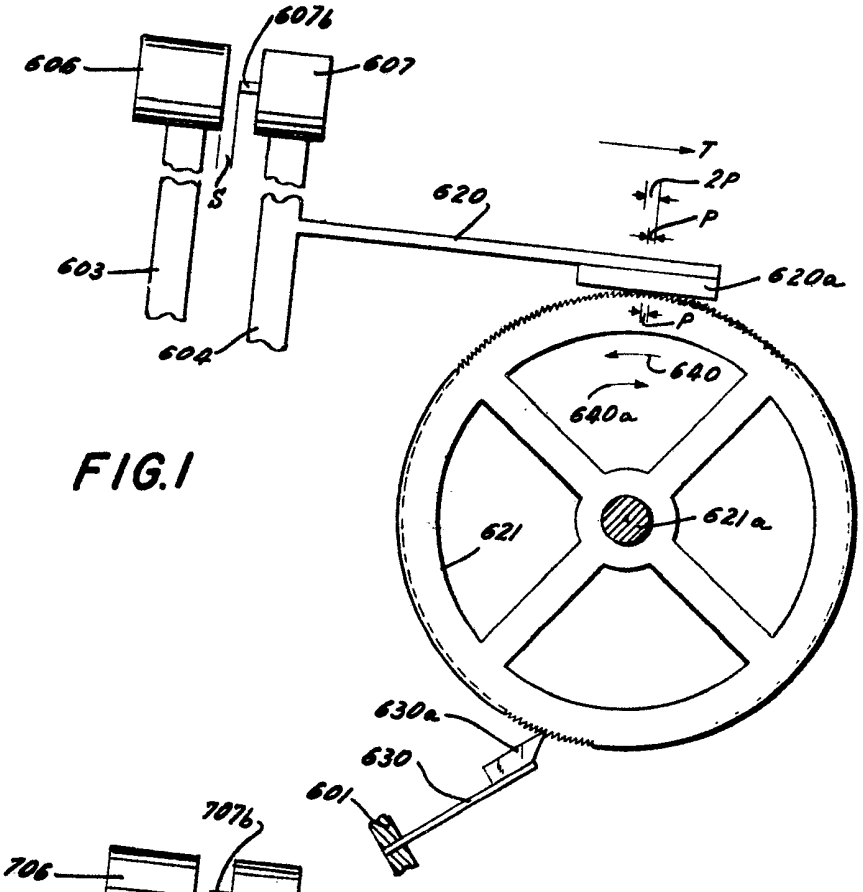

FIG.1

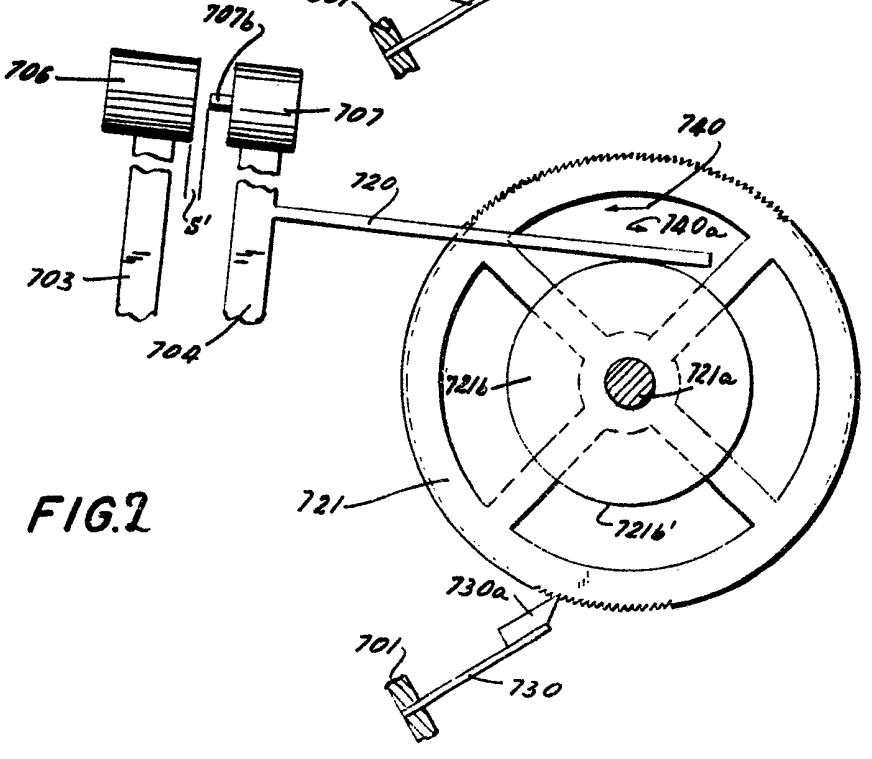

FIG.2