June 13, 1933. L. HATOT 1,914,015

SELF WINDING WATCH

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Fig. 1

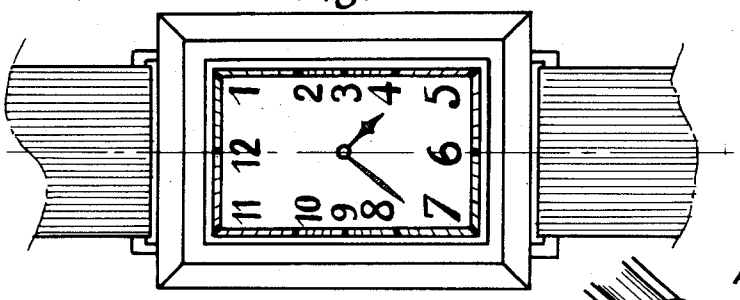


Fig. 2.

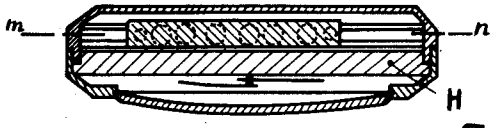


Fig. 3.

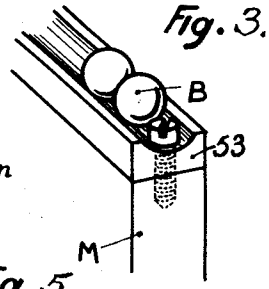
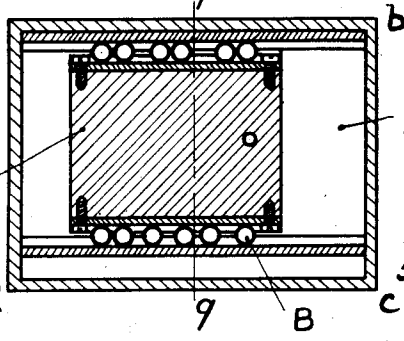


Fig. 5

Cross. Section. mn



Cross. Section pq

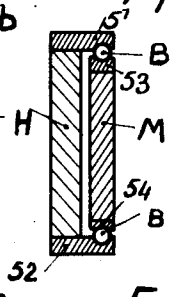


Fig. 4.

Fig. 8

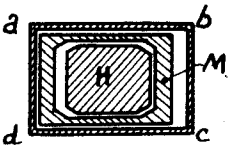


Fig. 9

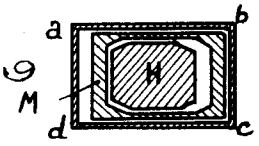


Fig. 6.

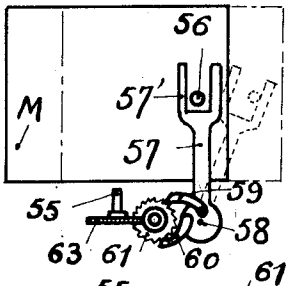


Fig. 11

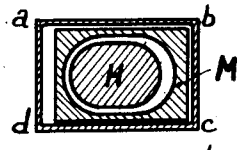


Fig. 12

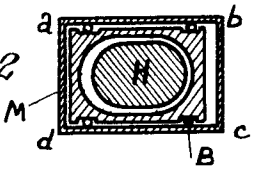
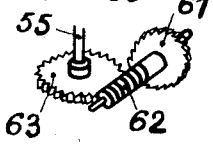


Fig. 7.



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Fig. 13.

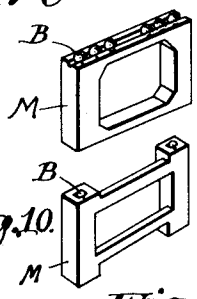


Fig. 10.

Fig. 15a. Fig. 15.

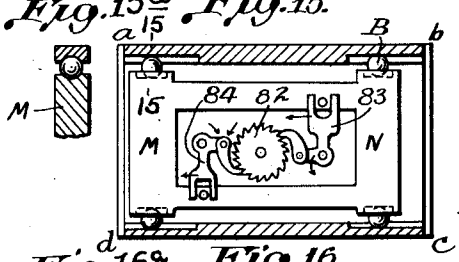


Fig. 19.

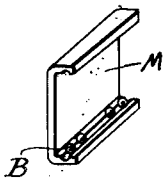


Fig. 16a. Fig. 16.

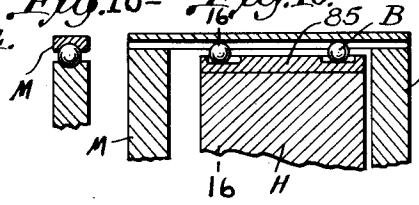


Fig. 14.

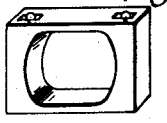


Fig. 23.

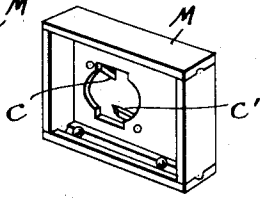


Fig. 17.

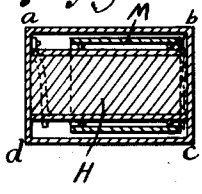


Fig. 18.

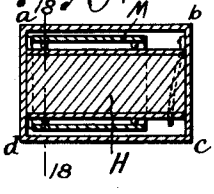


Fig. 18a

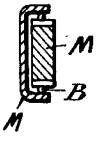


Fig. 24.

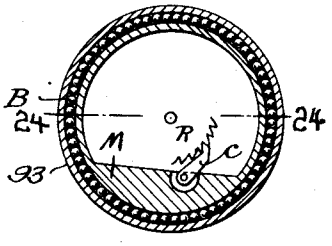


Fig. 20.

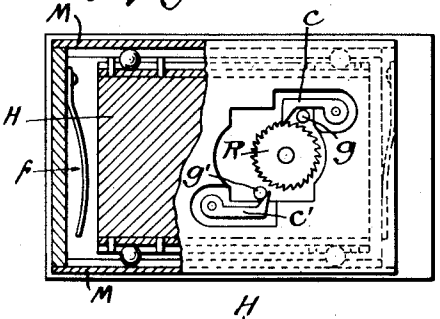


Fig. 21.

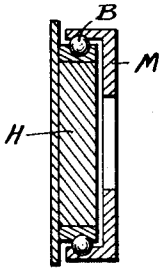
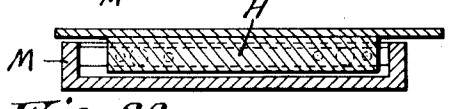


Fig. 22.



92 93

Fig. 24a

Fig. 25.

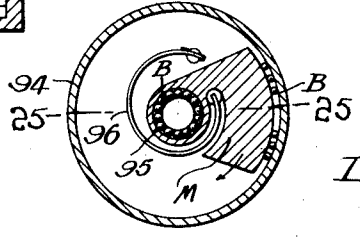


Fig. 25a



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Fig. 26.

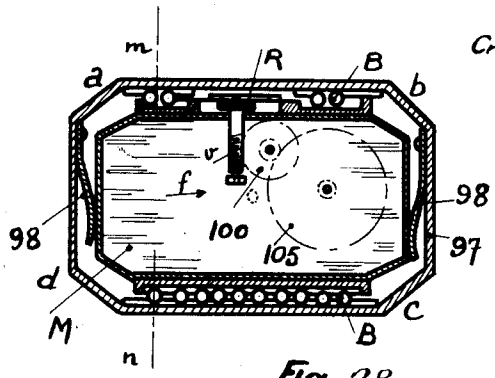


Fig. 27.

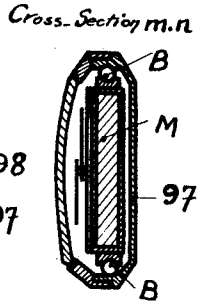


Fig. 28.

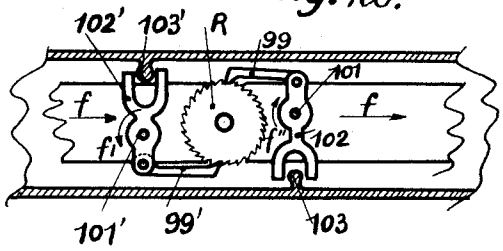
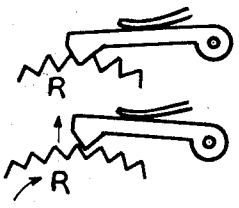


Fig. 29.



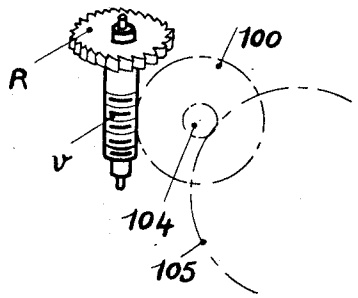


Fig. 30.

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June 13, 1933. L. HATOT 1,914,015

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Fig. 31.

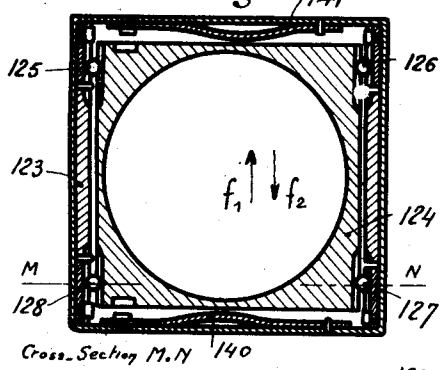


Fig. 33.

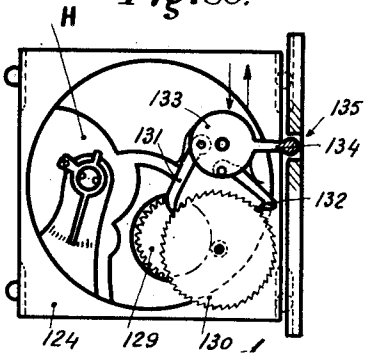


Fig. 32.

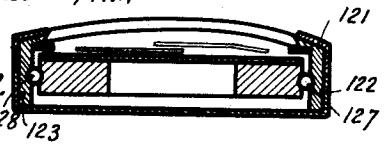
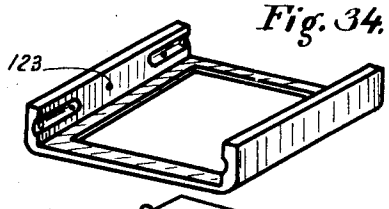


Fig. 34.



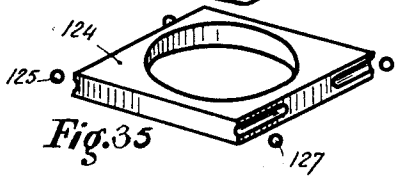


Fig. 35

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By: Mark Allen
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Patented June 13, 1933 1,914,015

UNITED STATES PATENT OFFICE

LÉON HATOT, OF PARIS, FRANCE

SELF WINDING WATCH

Application filed July 24, 1930, Serial No. 470,473, and in France January 11, 1930.

Several systems of self-winding watches have already been proposed which are wound up under the action of the shocks to which they are submitted. Such are those built by the well known watchmaker A. L. Breguet towards 1780.

In such systems, the movements of the watch are made use of for providing the reciprocating angular displacement of a driving mass which is not in equilibrium. This mass acts through a catch on a ratchet wheel adapted to rotate in a given direction and ensures the winding up of the driving spring by means of a reducing gear.

All the systems of this kind executed heretofore show the following drawbacks.

1. The oscillating driving mass is pivotally secured and as this mass is heavy and not equilibrated and receives often comparatively violent shocks, the pivots are easily damaged. It is therefore necessary to give them a large diameter and to provide guiding means which cause of necessity important sliding frictional losses of energy. Consequently the driving mass moves only by means of comparatively violent movements whereas small displacements of the watch which are the most frequent have no useful effect for the winding up of the watch.

In other systems the driving mass is held by springs.

2. The driving weight moves only over a comparatively small portion of the circumference. Moreover the displacements are made use of in only one direction for driving the ratchet wheel through the catch. Consequently only a small portion of the movements of the watch is made use of for winding the watch up. In effect the directions of the shocks and the movements favorable for winding the watch are comprised in a very small angular zone; as soon as the direction of movement passes to some extent beyond the perpendicular to the radius passing through the center of gravity, the momentum of inertia of the driving mass is compensated by the reaction of the pivot guiding parts.

My invention has for its object improvements in the above described systems. These improvements relate in the first place to means for suppressing the sliding friction and for making use of a far greater portion of the movements of the watch for winding it up. Thus the winding up may be ensured by means of one or more smaller driving masses or else with the same working condition, the efficiency is improved. This result is of particular interest in the case of pocket or wrist watches which must be small sized and may be submitted only to slow and infrequent movements during a long time.

My invention has also for its object several advantageous forms of execution of the parts and means for setting the hands right.

According to my invention the driving mass instead of being pivotally secured to an axis or of being guided by springs bears on rollers or balls moving freely over a roller path so as to almost completely do away with sliding friction.

For instance the driving power required for winding up the driving spring is provided by one or more metal balls guided over one or more roller paths under conditions such that the movements of the watch in different directions are made use of for driving the balls and acting on the winding up means.

The balls or the like driving masses act not only through their weight and inertia but also through their kinetic energy the value of which is increased in the following manner.

When the watch begins to move the balls or the like driving weights begin moving freely without acting on the winding up device, only when they have acquired a certain speed, do they act on the winding up system. Consequently the driving impulse is furthered at the start and the kinetic energy is gradually used for producing the required effect with considerable intensity. I may under such conditions, make use of very small movements which would be without action with the old winding up systems because in this latter case the force opposed by the driving spring of the watch and the friction provided thereby acts immediately on the driving mass and may prevent it from starting,

which is greatly detrimental to the sensitivity of such systems.

My invention has also for its object means whereby both directions of motion of the driving masses are used for winding up purposes. To this end the transmission of their motion to the rotary shaft of the watch driving spring is not ensured by an ordinary catch but by a mechanism affording means for adding the effects of the forward and return movements, the latter being used after reversal.

I have shown by way of example on accompanying drawings several forms of execution of my invention.

Fig. 1 shows a narrow thin rectangular wrist watch on its dial side, using standard sized parts and provided with winding up masses according to the invention.

Figs. 2 to 5 show the same watch in other positions, with certain parts in cross-section the movable part formed by a thin rectangular part moving parallel to the watch dial.

Figs. 6 and 7 show the transmission between the weight and the watch driving spring.

Figs. 8 and 9 show another arrangement wherein the driving mass passes round the inner mechanism and moves with a movement of translation.

Figs. 11 and 12 illustrate a modification thereof.

Figs. 10, 13 and 14 are perspective views of the general shape given to the movable mass.

Fig. 15 shows in detail the means for ensuring with very slight friction the guiding of the movable mass by means of balls together with the device for transmitting the motion of the driving masses to the driving spring.

Fig. 15*a* is a section on the line 15—15 of Fig. 15.

Fig. 16 is a modification of the arrangement shown in Fig. 15.

Fig. 16*a* is a section on the line 16—16 of Fig. 16.

Figs. 17, 18 and 19 show a modification in the driving mass.

Fig. 18*a* is a section on the line 18—18 of Fig. 18.

Figs. 20 to 23 show a further modification of the driving mass appearing as a comparatively thin box surrounding the rectangular clockwork on its sides and rear.

Figs. 24 and 25 show two modifications of a round pocket watch.

Figs. 24*a* and 25*a* are sections, respectively, on the lines 24—24 and 25—25 of Figs. 24 and 25.

Figs. 26 and 27 show an arrangement of a wrist watch wherein the clockwork may move with reference to the casing so as to form the oscillating driving mass.

Figs. 28, 29 and 30 show in detail the means for controlling the winding up in the arrangement of Figs. 26 and 27.

Fig. 31 shows the main parts of a square watch with the general arrangement of the stationary box and the movable part carrying the clockwork the small movements of which with reference to the casing ensure the automatic winding up of the watch.

Fig. 32 is a sectional view corresponding to Fig. 31.

Fig. 33 shows the clockwork seen from the side opposed to the dial.

Fig. 34 is a perspective view of the stationary part serving as a race for the movable clockwork.

Fig. 35 is a perspective view of the movable support of the time mechanism.

In Figs. 1 to 5 the clockwork H is rectangular and the mass M is constituted by a thin rectangular plate of a heavy metal.

This driving mass moves by a movement of translation and is carried behind the clockwork H at a small distance thereof. It may be guided by mere slideways but it is preferable to interpose balls or rollers B for ensuring a greater mobility. To this end the clockwork H is provided on its sides with two steel ball races 51 and 52. The mass or plate M is also provided with ball races 53 and 54 as shown in Figs. 3 and 5. The balls are disposed between the parts 51 and 53 on one hand and the parts 52 and 54 on the other. They must not be in tight contact so as to allow their easy rolling while removing any sliding friction.

The control of the barrel may be ensured through the usual winder up spindle 55 of the clockwork. To this end the movable plate carries a pin 56 engaging with play the inside of the fork 57 of an arm pivotally secured at 58. To this arm are pivotally secured at a small distance of its axis two catches 59 and 60 which make the ratchet wheel 61 rotate. I obtain thus a comparatively high torque for controlling the ratchet wheel and the arrangement of the catches is such that the movements of the plate M in both directions are made use of. The ratchet wheel is integral with a worm 62 meshing with the wheel 63 keyed to the winder up spindle.

The working is similar to that described hereinabove. To the plate M may also be added a coil or blade spring urging it back into its mean position, so as to cause it to oscillate under the action of a shock. It is of interest in practice to choose the natural frequency of the oscillating system in a manner such that it corresponds to the most frequent rhythm of human movements which may be determined experimentally.

In Figures 8 to 12 the movable mass M surrounds the clockwork H and moves with a reciprocating motion parallel to one of the sides of the rectangular casing *abcd*. The transmission of the movement of this mass M to the shaft of the driving spring may be

ensured by the arrangement shown in Figs. 6 and 7 or any other similar means.

The mass M may be guided in any suitable manner and in particular as shown in Figs. 15 and 16. According to Fig. 15, the movable mass has the shape shown in perspective in Fig. 10. The mass M is guided by the rectangular casing of the watch with the interposition of four balls B which may roll freely in races formed by semicircular grooves in the casing and mass.

The ratchet wheel 82 may be driven in both directions by the mass M through the catch arms 83 and 84 acting as disclosed with reference to Fig. 6.

In the arrangement shown in Fig. 16, the mass M is guided by balls B moving in ball races 85 provided in the clockwork H. In Figs. 17, 18 the mass M appears as shown in perspective in Fig. 19. This arrangement allows an important weight to be obtained by means of a thin part having a large surface.

I may thus increase only by a small amount the width and breadth of the clockwork which is of great interest for wrist watches. In jewelled watches, the mass M may be made of a heavy metal such as gold.

Figs. 20 to 22 show another arrangement of the watch with a driving mass having the shape shown in perspective on Fig. 23. According to this arrangement the mass completely surrounds the clockwork H except on the dial side. Consequently its surface is considerable and even with a reduced thickness, its weight may be considerable. Under these conditions it is possible to wind the watch up by means of movements of small amplitude. The catches CC′ actuating the ratchet wheel R may be directly secured to the driving mass M.

To improve the mobility of the part M, I may use the arrangement shown in Fig. 20. Near the catches are disposed the two stationary pins g and g_1. When the mass M is in the position shown in Fig. 20 i. e. when the mass M is at the left end of its path, the catch C meshes with the ratchet wheel R whereas the catch C′ is held away by the pin g' acting on the sloping part of its operative end. When owing to a movement of the watch under the action of a shock, the mass M moves in the direction f, the mass starts freely as the catch C′ is not in engagement. After a certain travel the catch C′ is released from the pin g' and makes the ratchet wheel R rotate. The catch C is lifted by the pin g. The same operation is effected during the return movement of the driving mass in the direction opposite to f.

Fig. 24 relates more particularly to round pocket watches; the control mass M has no pivots and is secured to the inner large diameter ring 92 which is adapted to rotate freely inside the outer ring 93. Between the rings 92 and 93 are small diameter rings and the whole works as a ball bearing of large diameter the inner ring of which is unbalanced and controls the winding up means through its displacements. To this end the mass M carries a catch C acting on the ratchet wheel R. These parts may be given a diameter equal to that of the catch and executed as flat parts disposed against the clockwork. They may also be disposed round the watch.

Fig. 25 shows a modification in the device shown in Fig. 24. According to this arrangement, a central ball bearing is provided at the centre of the casing.

I may also make use of a flat vibrating part held through a spring and guided laterally by a device providing no friction such as balls or carefully pivoted connecting links.

Fig. 25 shows also an arrangement according to this principle. To the mass M is secured one of the ends of a spring 96. The other end is secured to a stationary point. The whole may oscillate and the spring is chosen in a manner such that the natural frequency of the mass M associated with the spring 68 corresponds to a walking rhythm. Under such conditions the watch will be more specially wound up when the wearer is walking.

A form of execution of small elongated wrist watches wherein the clockwork is used as a control mass is shown in Figs. 26 and 27.

The clockwork is shown at M and slides between slideways in the watch casing 97. Balls B allow sliding friction to be avoided. Moreover the clockwork may be returned into its normal central position in the box by the spiral springs or spring blades such as 98. These must however be sufficiently yielding to allow the mass M constituted by the clockwork to move under the action of the shocks. They serve for damping the shocks.

The relative displacement of the mass M with reference to the casing may control the winding up means through any of the above described devices. I may also use the transmission shown in Figs. 26, 28 and 30.

To the side of the clockwork is disposed the ratchet wheel R on the toothwork of which may act the catches 99 and 99′ pivotally secured to the forked arms 102 and 102′ adapted to pivot round the spindles 101 and 101′ secured to the movable clockwork M. The casing carries driving projections 103 and 103′.

The wheel R is integral with the worm v meshing with the wheel 100 integral with the pinion 104. The latter engages the wheel 105 keyed to the barrel shaft.

The working is as follows:

Under the action of the shocks the mass M of the clockwork oscillates with reference to the casing. The projections 103 and 103′ move with reference to the axes 102 and 102′ whereby the catches are caused to make the

ratchet wheel R advance and wind up the spring. This arrangement allows an ordinary watch clockwork to be used without any great modification. The control means for the winding up is constituted by small strong parts. The clockwork H may moreover be enclosed in a thin envelope provided with a few apertures for the passage of the hands. This in combination with the outer casing affords an excellent protection against dust.

In the precedent systems the tension of the driving spring may be limited by the use of catches having a rounded end whereby these catches disengage the toothwork as soon as the resistant work exceeds a predetermined value.

I may obtain the same result by using a ratchet wheel the teeth of which have a tendency to be raised (see Fig. 29).

In Figs. 31 and 32 the casing 121—122 is integral with a stationary part 123 forming a frame wherein may slide the movable support 124 carrying the round clockwork shown in Fig. 33.

The support 124 may move over a small length in the direction of the arrows f_1 and f_2. To reduce the friction I may, instead of using mere slides, interpose balls 125, 126, 127 and 128 between the parts 123 and 124. Figs. 31 to 33 show the arrangement of these balls which is similar to those described hereinabove.

The parts 123 and 124 are shown separately in perspective in Figs. 34 and 35. They may be made of a very hard metal different from that forming the casing and the plate of the clockwork.

The clockwork H shown in Fig. 33 is in part similar to the clockworks of ordinary watches. The barrel ratchet wheel 129 meshes with a pinion integral with the ratchet wheel 130 of comparatively large diameter having a very fine toothwork. This ratchet wheel is submitted to the action of the catches 131 and 132 pivotally secured to the part 133—carrying an arm 134 the end of which engages a notch 135 in the support 123 carried by the stationary casing.

The working is the same as hereinabove under the action of the movements and shocks of the watch. The part 124 carrying the clockwork reciprocates in the direction of the arrows f_1 and f_2. These displacements being of small magnitude do not prevent the time from being read. The end of the arm 134 moves inside the stationary notch 135 to an extent smaller than the movement allowed for the clockwork H. At the ends of its patch the support 124 comes against the damping springs 140 and 141.

During the displacements of the clockwork H with reference to the casing, the catch carrier part 133 rotates with reference to the clockwork and the catches 131 and 132 make the ratchet wheel 130 rotate which in its turn makes the barrel shaft rotate and wind up the watch.

What I claim is:

1. A watch with automatic winding by the shocks, comprising a casing, a movable mass in the said casing, ball bearings interposed between the movable mass and the casing, races formed on the one hand on the movable mass and on the other hand on the casing, the said races having a length sufficient that when the movable mass effects its maximum displacement of amplitude, the balls roll constantly without sliding in their races, a clockwork, means for transmitting the oscillations of the movable mass to the clockwork.

2. A watch with automatic winding by the shocks, which comprises a rectangular mass movable on ball bearings in a stationary rectangular casing, elastic stops fixed on the two other sides of the stationary rectangular casing, the ball bearing comprising four balls arranged in pairs on both opposite sides of the movable rectangular mass, each of the ball placed in proximity of one of the angles of the movable mass being disposed between stops formed on the one hand on the movable mass and on the other hand on the stationary casing, the space between the stops being large enough so that the balls roll constantly without sliding along their races over the movable mass, a clockwork means for transmitting the oscillations of the movable mass to said clockwork.

3. A watch with automatic winding by the shocks, which comprises a movable rectangular mass constituted by the movable clockwork in a stationary rectangular casing, ball bearings interposed between the movable mass and the casing, races formed on the one hand on the movable mass and on the other hand on the casing, the said races being of sufficient length so that the balls roll over the movable mass without sliding, means for utilizing the oscillations of the movable mass to wind the spring of the clockwork.

4. A watch with automatic winding by the shocks, which comprises a movable rectangular mass, a thin casing, a rectangular box secured in the thin casing, ball bearings between the movable mass and the fixed box, races formed on the one hand on the movable mass and on the other hand on the box, the said races having a length sufficient to permit the balls to roll over the movable mass without sliding, elastic stops limiting the travel of the movable mass, means for utilizing the oscillations of the movable mass to wind the spring of the clockwork.

5. A watch with automatic winding by the shocks, which comprises a movable rectangular mass constituted by the clockwork, a thin casing, a rectangular box secured in the thin casing, ball bearings between the movable mass and the fixed box, races formed on the

one hand on the movable mass and on the other hand on the casing, the said races having a length sufficient to permit the balls to roll over the movable mass without sliding, elastic stops limiting the travel of the movable mass, means for utilizing the oscillations of the movable mass to wind the spring of the clockwork.

In testimony whereof I have affixed my signature.

LÉON HATOT.