The present invention relates to improvements in self-winding watches having an oscillating weight therein mounted on a swing arm for winding the main spring of the watch by means of a pawl cooperating with a winding ratchet.

Although self-winding watches actuated by an oscillating weight have been known in various designs, the swing arm generally consisted of a single element at the end of which the pendulum or oscillating weight was mounted so as to move in a certain direction, for example, along a circular path.

Furthermore, inasmuch as the ratchet mechanism was moveable in only one direction, watch movements of this type generally were able to utilize the movement of the weight or pendulum in only one direction to wind the watch, thus wasting at least the other half of its oscillating motion. Those self-winding watch movements, on the other hand, in which the ratchet drive was also actuated by the backstroke of the oscillating weight always required a complicated gear mechanism or other intricate translating device for winding the watch spring.

It is the primary object of the present invention to improve the self-winding mechanism of watch movements, and the principal feature of the invention consists in a watch provided with two paws which are preferably operative in the direction of movement of the oscillating weight but in opposite directions to each other.

Another important feature of the invention resides in providing two spaced mounting elements for flexibly connecting the watch casing with the weight or pendulum.

Another feature of the invention resides in alternatively providing at least two paws if there is only one mounting element or only one pawl if there are two mounting elements. Such single pawl will generally be sufficient for adequately winding the watch since the oscillating weight will then be safely mounted by being secured on two mounting elements. If it be desired, however, that the watch be wound more quickly, then it will be preferable to provide at least two pawls even though there are two mounting elements according to the invention to connect the oscillating weight with the watch casing.

Another feature of the invention consists in providing the oscillating weight so as to be moveable within a plane parallel with the plane of the watch dial.

When using two paws for transmitting the movements of the oscillating weight, still another feature of the invention consists in mounting such paws at opposite sides of the ratchet with which they cooperate to wind the watch.

Particularly when mounting the oscillating weight on a rigid swing arm, another important feature of the invention and the arrangement of two pawls resides in the combination and cooperation of a winding ratchet mounted at one side of the direction of the central swing arm with the two pawls mounted either on the swing arm or on the oscillating weight itself, and one behind the other in the direction of the swing arm, with both pawls operating in the direction toward the winding ratchet and acting as a pushing and pulling pawl, respectively.

When supporting the oscillating weight or pendulum by means of two mounting elements, they may, according to another embodiment of the invention consist of two parallel, rigid connecting rods, both of which are pivotally mounted within the plane of movement on the oscillating weight and the watch movement or watch casing, respectively. According to another preferred embodiment of the invention the two mounting elements may, however, also consist of two leaf springs, preferably of equal strength and size, the plane of the flat surfaces of which are vertical to the plane of movement and which are rigidly secured, at least at one end, preferably to the watch movement or watch casing.

Another object and feature of the invention resides in the provision of an attenuation device for suppressing the swinging movement of the oscillating weight relative to the watch or watch casing.

A further feature of the invention applicable particularly to a watch movement of round shape, but with certain minor modifications likewise applicable to other shapes, consists in an oscillating weight which preferably has the shape of a semicircular disk of a diameter slightly smaller than the watch movement, and mounted on the side of the watch opposite to the dial in such a manner that its semicircular periphery when in its central position is concentric with the watch movement.

It has further been found that the material most suitable for making the leaf springs and/or the attenuation springs according to the invention consists of an alloy of nickel and beryllium, copper and beryllium, or copper, beryllium and bronze.

Further objects, features, and advantages of the present invention will be apparent from the following detailed description thereof and the accompanying drawing, wherein—

Fig. 1 is a plan view of the self-winding mechanism of a watch according to the present invention with a pendulum weight rigidly secured to a resilient springlike swing arm.

Fig. 2 is a plan view of the self-winding mechanism similar to that shown in Fig. 1, but with the pendulum weight pivotally mounted on a rigid swing arm;

Fig. 3 is a plan view of a similar self-winding mechanism with the pendulum weight mounted on a pair of equal leaf springs;

Fig. 4 is an enlarged plan view of the resilient bearing of a leaf spring of the self-winding mechanism as shown in Fig. 3;

Fig. 5 is a front view, partly in section, of the bearing shown in Fig. 4 as seen in the direction of the arrow V therein.

Fig. 6 is a plan view of the self-winding mechanism of a watch according to another modification of the invention; while

Fig. 7 shows a modification of the attenuation device shown in Fig. 3.

Referring to the drawings, the self-winding mechanism according to the first embodiment of the invention shown in Fig. 1 consists of an oscillating weight 1 which is secured to a leaf spring 2 which, in turn, is tightly clamped by the elements 3 near the outer edge of the watch movement 4 and mounted so that in the central position of the pendulum 1, as shown in the drawing, the plane of the leaf spring 2, when continued inwardly intersects with the central axis of the watch movement. Laterally of this central direction of the leaf spring 2 constituting the swing arm of the pendulum weight 1 is a winding ratchet 5 which is connected to the watch movement in a manner not particularly shown, for example,
through an intermediate reduction gear, for winding the main spring of the watch.

At its point of connection with the leaf spring 2 the oscillating weight or pendulum 1 is provided with an extending arm 13 extending toward the mounting 5 of that mounting 5 of that mounting.

The winding ratchet 5 is mounted laterally of the extension 6 and at a small distance therefrom. As shown in Fig. 1, this extension 6 carries a pulling pawl 7 and a pushing pawl 8 pivotedly mounted thereon, one behind the other in the direction of the spring arm 2 of the pendulum, and both pivoting in the direction toward the winding ratchet 5 and being in engagement therewith at diametrically opposite points thereof. Both pawls 7 and 8 are acted upon by a spring 9, likewise mounted on the extension 6 so as to remain in engagement with the ratchet 5 at all times. Each pawl is also provided with several teeth 10 so that such engagement with the ratchet 5 will also be insured even though pendulum 1 should carry out more extensive oscillatory movements. A separate lock pawl 11 mounted on the watch movement 4 and held under spring pressure may also be provided to prevent the ratchet from moving independently counterclockwise, that is, opposite to that of winding the watch. Usually, however, such separate lock pawl will not be required since one of the two pawls 7 or 8 which does not shift the ratchet 5 in a clockwise direction at that particular time exerts a safe locking action upon the ratchet even at the time immediately after the other pawl has shifted the ratchet.

The operation of the self-winding mechanism as shown in Fig. 1 is as follows:

If the pendulum weight 1 oscillates as the result of a vibration, jarring, or displacement of the watch movement 4 in a clockwise direction about the mounting 3 of the leaf spring 2, the pushing pawl 8 transmits such movement upon the ratchet 5, thus winding the main spring of the watch, the pulling pawl 7 then simultaneously sliding along the other side of the ratchet 5 without acting thereon. As soon as the movement of the pendulum weight 1 is reversed, the pulling pawl 7 engages actively into the teeth of the ratchet 5, continuing the winding movement of the ratchet 5 in the same direction during the succeeding return movement of the oscillating weight. During such return movement the upper pushing pawl 8 slides along the teeth 10 of the ratchet 5 without acting thereon. Thus, any oscillatory movements of the pendulum 1 within its plane of oscillation will be utilized for turning the ratchet 5 in the same direction to wind the watch.

The self-winding mechanism according to the modification of the invention as shown in Fig. 2 essentially consists of an oscillating weight or pendulum 12 which is rotatably mounted at the lower edge of a watch movement 14 in a bearing 15 on a rigid arm 13 extending therefrom and forming an integral part thereof. A leaf spring 17 mounted at a point 16 of the watch casing remote from the central position of the arm 13 presses upon the end surface 18 thereof which projects beyond the bearing 15, thereby resiliently tending to maintain the pendulum in such a position. Thus, any swinging movement of the pendulum 12 results in a corresponding inclination of the end surface 18 relative to the leaf spring 17, the latter then tending to return the pendulum 12 to its central position. The position and operation of the ratchet 5 and of the pulling and pushing pawls 7 and 8 mounted on said pendulum arm 13 is identical with that shown in Fig. 1 and described above, a repetition of such disclosure of the operation of the pendulum thus being unnecessary.

In place of a straight leaf spring as shown in Fig. 1, it is also possible to apply a curved or bent leaf spring. Further, the winding ratchet does not need to be located laterally of the pendulum arm, nor is it necessary that the two pawls extend from the pendulum arm in the same direction. It may, on the other hand, be preferable to combine a winding ratchet, which is mounted adjacent to the pendulum arm within the direction of its central position, with two pawls which are mounted directly on the pendulum arm or the pendulum weight itself. In such event, one pawl which lies adjacent to the center of oscillation relative to the winding ratchet is mounted at one side of the pendulum arm and offset in the direction of oscillation, while the other pawl which lies opposite to the center of oscillation relative to the winding ratchet is mounted at the other side of the pendulum arm and offset in the direction of oscillation, both pawls being opposed to each other and directed toward the winding ratchet, and together acting upon the ratchet either as pushing or pulling pawls depending upon the rotary direction in which it is wound. Furthermore, it is advisable to provide the teeth of one pawl at a larger distance from each other than those of the ratchet. Finally, the resilient restoring force may be produced by any other known means rather than by the leaf spring 17.

The third modification of the invention, as shown in Figs. 3 to 5 consists of an oscillating weight 19 in the shape of a semicircular disk which, secured to the watch movement 21 by means of two leaf springs 20, is substantially concentric with the round watch movement 21 when in its central position, the diameter of the weight 19 being slightly smaller than that of the watch movement 21. The leaf springs 20 used as mounting elements extend when in their released central position from the straight edge 22 of the weight 19 in a straight line and parallel to each other toward the opposite edge of the watch movement by means of a mounting plate 23. They are spaced from each other along their entire length a distance substantially corresponding to half the diameter of the oscillating weight 19, the plane of their flat surfaces lying vertically to their plane of movement and thus to the plane of oscillation of the weight 19, and preferably consist of an alloy of copper and beryllium.

The area of the watch movement enclosed by the weight 19 and the leaf springs 20 contains a ratchet 24 for winding the main spring of the watch and extending from the plane of the surface of the watch movement into this area. The weight 19 has near its lower end a recessed portion 25 into which the two leaf springs 20 extend, and which is covered by a face plate 26 which is firmly screwed to the weight 19. Near the end of each leaf spring 20 the face plate 26 and the weight 19 are each provided with a bore 27 extending parallel to the plane of the leaf spring and vertically to the latter, and serving as a bearing for a pivot pin 28 which is firmly secured to the end of the respective leaf spring 20 and is rotatably mounted at both sides of the spring in the bores 27. As shown particularly in Figs. 4 and 5, each pivot pin 28 consists of a central part 29 of larger diameter which is surrounded by the end 30 of the leaf spring 20. The firm mounting of the end 30 of the leaf spring on the central part 29 of the pivot pin 28 is obtained by a sleeve 31 tightly fitting over the pivot pin and the end 30 and slotted at the point where leaf spring 20 is inserted therein.

A further bore 32 in the weight 19 and the cover plate 26 serves as a bearing for a pawl 33 which is designed as a pushing pawl and cooperates with the winding ratchet 24 so as to turn the latter in one direction of the oscillation for winding the same. For insuring the engagement between the pushing pawl 33 and the teeth of the ratchet 24 during the entire swing in this one direction, the pawl 33 is provided with two teeth 24, the distance between which is larger than that between the teeth of the ratchet 24. Aside from this, the engagement of the teeth is assured in the customary manner by means of spring 35 resiliently pressing the pawl 33 against the winding ratchet 24.

As illustrated in Fig. 3, laterally of the ratchet 24, the cover plate 26 also has an arm 36 extending in the direction of the mounting of the leaf springs 20 on the
watch movement 21. This arm 36 also carries a pushing pawl 37 directed toward the winding ratchet and cooperating therewith on the side opposite the weight 19 through the action of a spring 38 pressing the pawl 38 against the ratchet. Thus the movement of the weight 19 in one direction causes the pawl 33 which is mounted on the weight itself to push the ratchet 24 in the winding direction, while the movement of the weight 19 in the other direction is transmitted through the pawl 37 which is mounted on the arm 36 to continue such winding movement of the ratchet 24. The provision of an additional lock pawl in this embodiment of the invention will be unnecessary since at the end of the shifting movement of one pushing pawl the other will act as a lock pawl.

Opposite to the ratchet 24 the weight or pendulum 19 also carries an attenuation or stabilizing device which consists of a substantially U-shaped leaf spring 40 which is mounted in a cutout 39 in the central part of the pendulum weight. The two arms 41 and 42 of the spring 40 extend from the cutout 39 cooperate with an outer stop pin 43 secured on the watch movement 21. This stop pin 43 is placed so that in the central position of the weight 19 it will lie in the middle between the two arms 41 and 42 of the spring 40. Furthermore, another stop pin 44 is provided outside and between the two arms 41 and 42 of the attenuation spring 40 against two stop pins 45 and 46 of the circular cutout 39, the spring 40 in its neutral position then being spaced a certain distance from these stop pins 44 as well as from the outer edges 45 and 46 of the cutout 39, the distances between the spring 40 and the stop pins 44 being smaller than the distances between the two arms 41 and 42 and the edges 45 and 46. Such design and arrangement of the attenuation or stabilizing spring 40 produces a resilient, gradually increasing attenuation effect from the moment when one of the arms 41 or 42 thereof abuts against the stop pin 43, such effect being attained at first by the arm abutting against one of the stop pins 44 and then also by its abutting against the adjacent edge 45 or 46 of the cutout 39.

The self-winding mechanism according to the fourth modification of the invention as shown in Fig. 6 likewise consists of an oscillating or pendulum weight 19 of substantially semicircular shape which, secured to the watch movement 21 by means of two leaf springings 49 is substantially concentric with the round watch movement 21 when in its central or neutral position. The weight 19 is likewise slightly smaller in diameter than the watch movement 21 so that there will be sufficient space for the weight 19 to swing between it and the watch casing 50. The leaf springs 50 are firmly clamped against the arc of the weight 19, by means of a mounting plate 53 by means of a mounting plate on the edge of the watch movement, and extend from their mounting points at first along a straight line and parallel with, and at a certain distance from each other in the direction toward the weight 19. Conversely, however, to the straight leaf springs 20 of the previous embodiment, the leaf springs 49 are bent near the weight 19 symmetrically at a right angle toward each other, and the free end of each of them extends in such a direction that, is parallel to the straight edge 22 of the weight 19, into an arm 51 or 52, respectively, on the weight 19 and a cover plate 53 similarly as shown in the previous embodiment.

Also, similarly a winding ratchet 24 is provided within the area enclosed by the weight or pendulum 19 and the leaf springs 49, and pushing pawls 33 and 37 are rotatably mounted on the weight 19 and the cover plate 53 so as to cooperate with the ratchet 24 in the manner as described with reference to the previous embodiment so that the ratchet will be taken along in the winding direction by the movement of the weight or pendulum 19 in either direction and parallel to the edge 22 thereof. The self-winding mechanism according to Fig. 6 accordingly contains two additional pushing pawls 54 and 55 pivotally mounted on the weight 19 and the cover plate 53 or the arm 51 thereof, respectively, which act upon the winding ratchet 24 in a direction vertically to the direction of movement of the other pawls 33 and 37. Thus, not only the vibrations of the weight 19 in the direction of the straight edge 22 of the weight are utilized for winding the ratchet 24 but also those vibrations of the weight which extend in a direction vertically thereto because of the angular extent of the leaf springings 49.

The oscillating weight 19 of this embodiment of the invention may also be provided with an attenuation or stabilizing device as illustrated in Fig. 5 which cooperates with the weight casing 50. It consists of leaf springs 56 mounted at opposite sides of the weight 19 which are rather flat in a curve outwardly from the weight 19 and produce an attenuating or stabilizing effect relative to an inner cylinder wall 57 of the watch casing 50. A slight modification of the attenuation device shown in Fig. 3 is finally illustrated in Fig. 7 wherein the stabilizing spring 40 mounted at its center in the cutout 39 in the weight 19 already abuts in its neutral position upon stop pins 44. However, similarly to the embodiment shown in Fig. 3, the arms 41 and 42 of the spring 40 are spaced in their neutral position a certain distance from the outer edges 45 and 46 of the cutout 39. The attenuation or stabilizing effect is produced by the action of the spring 40 against two stop pins 44 and 45 provided at such a distance from each other between the upper ends of the arms 41 and 42 of the spring that these ends are placed under a certain small initial tension. The attenuation device as shown in Fig. 7 thus already becomes effective at the first moment of a swinging movement of the weight 19 and increases after a certain deflection, as illustrated in Fig. 7 and as already described, the spring arms 41 and 42 abutting against the edges 45 and 46 of the cutout 39. This attenuation or stabilizing device is thus also adapted, for example, for self-winding mechanisms in which the weight is mounted on the watch movement by means of two rigid connecting rods. Finally, the attenuation device according to Fig. 7 has the advantage of acting as a sound absorber.

The present invention is by no means limited to the particular embodiments illustrated in the drawings. For instance, it is not absolutely necessary to use leaf springs as mounting elements for the weight or pendulum 19. The oscillation of the weight in accordance with Fig. 3 may thus be produced without additional torque, for example, by two rigid connecting rods which are preferably alike and parallel to each other and are pivotally mounted on the weight or pendulum and the watch movement or watch the plane of movement of the weight. The invention is, for example, not limited to a pivotal connection of the leaf springs with one of the two parts to be connected, and the ends of the leaf springs on the weight 19 or 19 may be rigidly secured to the weight. Furthermore, in a self-winding mechanism according to Fig. 6, the leaf springs may also be made of a different shape than that shown, and may in their released central position have any other suitable shape, the two springs, however, preferably being curved symmetrically toward each other. The pivotal mounting of the leaf springs may also be provided at the watch movement rather than at the weight as shown in Fig. 6, and such watch movement also does not have to be of round shape as illustrated but may have any other form. Similarly, the oscillating or pendulum weight is not required to have the semicircular shape as shown and may be designed in accordance with any other shape of the watch movement and the watch casing.

In the event of leaf springs being used, it has also been found that the proper selection of a suitable material therefor is of particular importance to realize the objects of the invention. Whereas steel springs or springs made of a steel alloy have been found to be rather unsuitable, experiments have shown that springs made of a copper-beryllium alloy are of particular ad-
vantage and that other beryllium alloys, especially alloys made of nickel and beryllium, and copper, beryllium, and bronze have proved very successful for this particular purpose.

What I claim is:

1. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, means for mounting said weight on said frame to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least two paws mounted on said weight engaging said ratchet, said paws being adapted to operate in opposite directions of movement of said weight to turn said ratchet in the same direction, the mounting means of said weight comprising a pair of substantially parallel connecting rods, and means for resiliently mounting one end of said rods on said frame and for pivotally mounting the other end of said rods on said weight.

2. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, means for mounting said weight on said frame to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least two paws mounted on said weight engaging said ratchet, said paws being adapted to operate in opposite directions of movement of said weight to turn said ratchet in the same direction, the mounting means of said weight comprising a pair of leaf springs of equal size and for rigidly mounting one end of said leaf springs on said frame and for pivotally mounting the other end of said leaf springs on said weight, the plane of the flat surface of said leaf springs being vertical to the direction of movement of said weight.

3. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, means for mounting said weight on said frame to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least two paws mounted on said weight engaging said ratchet, said paws being adapted to operate in opposite directions of movement of said weight to turn said ratchet in the same direction, the mounting means of said weight comprising a pair of spaced connecting members mounted on said weight and said frame near the outer edge thereof, means for rotatably mounting said ratchet in the area between said connecting members and said weight, said weight having a rigid arm near one of said connecting members and extending substantially in the direction toward the end where said connecting member is secured to said frame near the outer edge thereof, means for rotatably mounting one of said paws on said arm and so as to be directed toward said ratchet at one side thereof, means for rotatably mounting the other paw directly on said weight and so as to extend toward said ratchet in the opposite direction of said first paw and at the other side of said ratchet, said first paw turning said ratchet in the winding direction during the movement of said weight in one direction, and said other paw likewise turning said ratchet in the winding direction during the movement of said weight in the opposite direction, said paws extending in a direction generally parallel to the direction of motion of the weight.

4. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, means for mounting said weight on said frame to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least two paws mounted on said weight engaging said ratchet, said paws being adapted to operate in opposite directions of movement of said weight to turn said ratchet in the same direction, the mounting means of said weight comprising a pair of leaf springs of equal size spaced from each other and connecting said weight to said frame in a spaced relation thereto, said leaf springs when in their central released position extending in a straight line and parallel to each other.

5. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, means for mounting said weight on said frame to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least two paws mounted on said weight engaging said ratchet, said paws being adapted to operate in opposite directions of movement of said weight to turn said ratchet in the same direction, the mounting means of said weight comprising a pair of leaf springs of equal size spaced from each other and connecting said weight to said frame in a spaced relation thereto, said leaf springs each having a bearing at their inner end, and a pair of bearing pins on said weight for pivotally mounting said inner ends of said leaf springs thereon.

6. A watch having a casing, a main spring, and a self-winding mechanism for winding said spring within said casing, said mechanism comprising a watch movement frame, a weight, a pair of spaced leaf springs for mounting said weight on said frame so as to permit said weight to oscillate in opposite directions relative to a central neutral position and for resiliently tending to maintain said weight in said neutral position, a ratchet operatively connected to said main spring for winding the same, and at least one paw mounted on said weight and engaging said ratchet to turn the same so as to wind said main spring when said weight swings in at least one direction from said central position, said paw extending in a direction generally parallel to the direction of motion of the weight.

References Cited in the file of this patent

UNITED STATES PATENTS
1,914,015 Hatot June 13, 1933
2,623,349 Briderazau Dec. 30, 1952
2,769,301 Liebman Nov. 6, 1956

FOREIGN PATENTS
167,226 Switzerland Apr. 16, 1934
400,625 Germany Aug. 23, 1924