

Oct. 16, 1962

E. ZEMLA

3,058,294

INERTIA WOUND TIMEPIECE WITH MAGNETIC COUPLING MEANS

Filed June 11, 1959

2 Sheets-Sheet 1

Fig.1

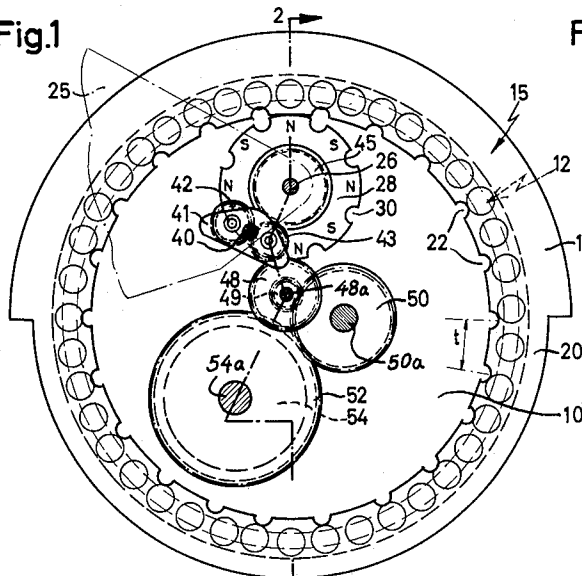


Fig.2

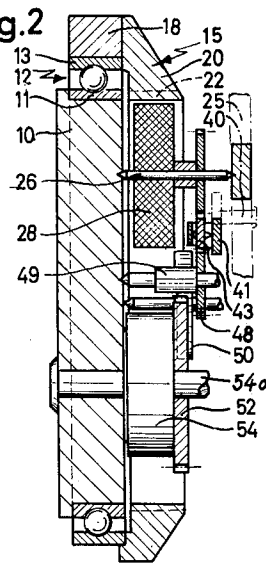


Fig.3

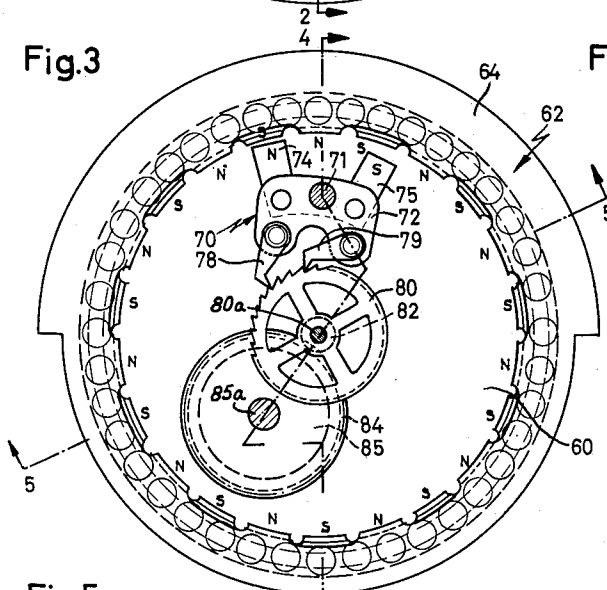


Fig.4

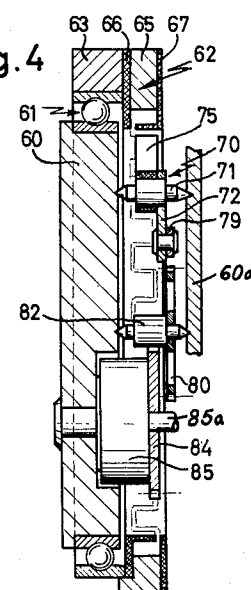
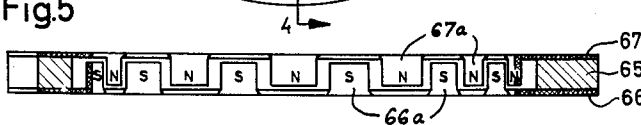


Fig.5



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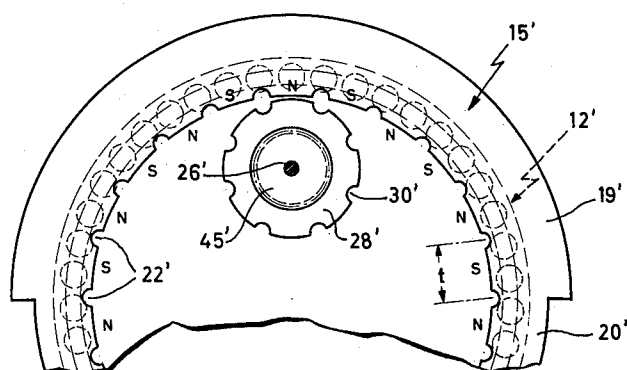


Fig. 6

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INERTIA WOUND TIMEPIECE WITH MAGNETIC COUPLING MEANS

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Filed June 11, 1959, Ser. No. 819,599

Claims priority, application Germany June 16, 1958
16 Claims. (Cl. 58—82)

The present invention relates to timepieces in general, and more particularly to a winding mechanism combined with an automatic disconnecting system therefor for use in self-winding wrist watches and like timepieces.

It is already known to provide in wrist watches an unbalanced element which is caused to oscillate upon movements of a wearer's body and/or hand, and to utilize such oscillations to wind the mainspring of the watch mechanism. It is a rather frequent occurrence in such types of timepieces that, when the wearer is active and performs a series of consecutive movements, the mainspring is wound all the way by the unbalanced element and the latter still continues its oscillations, thus tending to subject the mainspring to excessive tension. It is, therefore, necessary to provide a system, operating not unlike a friction clutch, which renders it possible that the unbalanced element may continue its oscillations without subjecting the mainspring to excessive tension, i.e., without tensioning the spring beyond a given limit. In presently utilized self-winding wrist watches and like timepieces, the problem of preventing excessive winding of the mainspring is solved by the utilization of a so-called trailing or lagging mainspring having an end which begins to slide along the inner side of its casing as soon as its tension reaches a predetermined maximum value. Such construction renders it necessary to determine and control with great precision the frictional forces existing between the mainspring and its casing in order to insure that the winding of the mainspring is definitely interrupted in response to a predetermined tension of the latter but not before, i.e., upon storing of sufficient energy in the mainspring which energy is then gradually released as the mainspring unwinds to operate the watch mechanism. Thus, the oscillations of the aforementioned unbalanced element should tension the mainspring as long as the frictional force between the mainspring and its casing is greater than the energy accumulated in the coiled spring, but the unbalanced element should begin to rotate the casing with respect to the mainspring as soon as the energy stored in the mainspring reaches its maximum permissible value, i.e., as soon as the mainspring is fully wound. This is presently accomplished by subjecting that end of the mainspring which is in contact with its casing and also the inner side of the casing to extensive treatment by coating same with special substances, e.g. certain lubricants, greases and the like. Such treatment, however, is seldom satisfactory since a truly accurate determination of frictional or entraining forces which develop between the mainspring and its casing is impossible, and also because the applied coating changes its consistency not only with time but also in response to changes in climatic and temperature conditions to thereby change the magnitude of the frictional forces acting between the mainspring and its casing.

An important object of the present invention is to provide a self-winding mechanism for the mainsprings of wrist watches and like timepieces, and disconnecting means therefor, which is so constructed that the mainspring will be wound by and automatically disconnected from the winding mechanism at a given magnitude of tension accumulated therein regardless of the frequency and number of successive windings performed by the mechanism.

Another object of the invention is to provide a mechanism

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of the above outlined characteristics which is so constructed that the exact time of its disconnection from the mainspring does not change regardless of the length of time during which a so constructed timepiece is in actual use.

A further object of the present invention is to provide a self-winding mechanism for the mainsprings of wrist watches and disconnecting means therefor which occupy very little space and thus do not unduly increase the dimensions of a timepiece.

An additional object of the instant invention is to provide a mechanism of the above described character which is reliable in use and whose winding action upon the mainspring does not weaken or change with time; which is of comparatively simple construction and can be embodied in wrist watches and other timepieces of different sizes and designs; and which may be combined with practically all existing types of watch mechanism without requiring any alterations, modifications or rearrangements thereof.

Still another object of the invention is to provide a self-winding timepiece in which the mainspring may remain permanently connected with its casing.

With the above objects in view, the invention resides essentially in the provision of an unbalanced element installed in a timepiece and adapted to oscillate or rotate, i.e. to perform angular movements, in response to the movements of a wearer's body and/or hand, and which is not directly coupled with the mainspring but is adapted to transmit motion to the latter only through a magnetic field of readily controllable strength, there being provided a magnetizable or magnet-carrying follower which is positively coupled with the mainspring to rotate and wind same, and is in turn angularly displaceable by the aforementioned unbalanced element as long as the resistance of the mainspring to further winding is less than the strength of the magnetic field established between the unbalanced element and the follower. As soon as the resistance of the spring to further winding exceeds the strength of the magnetic field, the follower cannot pursue the angular movements of the unbalanced element and the latter is thus effectively disconnected from the mainspring. As soon as the mainspring unwinds at least to a small extent, any subsequent angular movements of the unbalanced element will again cause angular movements of the follower and will result in renewed winding of the mainspring up to the point of given maximum tension.

By proper selection, dimensioning and shaping of the magnet or magnets, the strength of the magnetic field may be determined and maintained with sufficient accuracy to prevent excessive winding of the mainspring, i.e. the magnetic field will cause the follower to perform angular movements upon corresponding movements of the unbalanced element such as are necessary for normal winding of the mainspring, whereas a certain oppositely directed force of the fully wound mainspring which then resists further winding will effectively terminate the magnetic connection between the follower and the unbalanced element. The latter is then free to continue its oscillatory or rotary movements without, however, entraining the follower until such time when the energy stored in the mainspring is at least partially dissipated, i.e. utilized for operating the watch mechanism, to allow renewed winding of the mainspring.

The novel assembly may utilize permanent magnets or electromagnets, the former being preferred in normal types of wrist watches in order to render them operative without requiring a source of electrical energy. One or more permanent magnets may be provided on the unbalanced element and/or on the follower, if desired, it being only necessary to form a magnetic field whose strength is sufficient to cause angular displacements of the follower in response to angular displacements of the

unbalanced element such as are necessary for normal winding of the mainspring. For example, the arrangement may be such that only a portion of, or the entire, unbalanced element may bring about corresponding angular movements of the follower when the former rotates or oscillates upon movements of a wearer's body and/or hand. The follower may perform rotary or oscillatory movements, and it may be formed as a disc or as a two-or-more-armed body of non-circular contour.

It is often preferred, though not necessary, that the follower be mounted coaxially with and within the unbalanced element which latter is usually of substantially annular shape and is supported on a pillar plate with an antifriction bearing therebetween. On the other hand, the axis about which the follower moves may be disposed between the axis and the periphery of the unbalanced element. In this last-mentioned embodiment of the invention, the follower preferably assumes the shape of a rotatable discoid magnetic body and carries at least one pair of unlike magnetic poles on its peripheral zone. In such instances, the unbalanced element need not be a magnet but should merely consist of a magnetizable material. When the periphery of the follower is formed with more than one pair of magnetic poles, any rocking or rotary movements of the unbalanced element will be transmitted to the follower without any play or interruptions, which results in rather rapid winding of the mainspring, the latter being coupled with the follower in any known and convenient manner, e.g. by a gear train. It is desirable in such constructions to utilize a follower with pronounced pairs of poles, for example, by forming its peripheral zone with spaced recesses or cutouts which separate the adjacent unlike poles from each other. In order to increase the strength of the magnetic field, that surface of the unbalanced element which is turned toward the poles of the follower, too, may be formed with spaced recesses or cutouts whose mutual distance preferably equals that between the recesses formed in the follower.

In certain other instances, the follower preferably assumes the shape of a non-circular keeper or anchor which is merely rocked but never fully rotated by the unbalanced element when the latter performs its angular movements in response to the movements of a wearer's hand and/or body. The unbalanced element is then formed with a series of pole pieces or teeth facing the follower and cooperating with the latter's magnets in such a way that selected zones of the follower are alternately attracted toward and repelled away from the adjacent poles of the unbalanced element, this resulting in rocking movements of the follower which are transmitted, e.g., by a ratchet and pawl assembly, to the casing of the mainspring to wind the mainspring to a given extent whereupon the strength of the magnetic field between the poles of the follower and of the unbalanced element is too weak to bring about further rocking of the follower, and any excessive winding of the mainspring is thus effectively prevented.

The entire mechanism is installed in the watch case and, since it comprises a comparatively small number of component parts, i.e. an unbalanced element, a follower, and a gear train or the like for transmitting movements of the follower to the casing of the mainspring, the novel mechanism adds very little to the bulkiness of a so constructed timepiece. The end of the mainspring may remain permanently connected to its casing because the excessive winding of the mainspring is not prevented by causing its casing to move with respect thereto but rather by permitting the unbalanced element to continue its angular movements without entraining the follower.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best

understood from the following detailed description of certain specific embodiments when read in connection with the accompanying drawing, in which:

FIG. 1 is somewhat schematic front elevational view of one embodiment of my invention utilizing a one-piece unbalanced element and a rotatable follower of circular contour;

FIG. 2 is a transverse section taken on the line 2—2 of FIG. 1, as seen in the direction of arrows;

FIG. 3 is front elevational view of a slightly modified embodiment utilizing a composite unbalanced element and a rockable two-armed follower;

FIG. 4 is a transverse section taken on the line 4—4 of FIG. 3, as seen in the direction of arrows;

FIG. 5 is an axial section through the unbalanced element of FIG. 3 taken on the line 5—5, as seen in the direction of arrows; and

FIG. 6 is a fragmentary front elevational view of a third embodiment of my invention.

Referring now in greater detail to the illustrated embodiments, and first to that represented in FIGS. 1 and 2, there is shown a pillar plate 10 having a circular peripheral zone whose outer surface is connected with the inner race 11 of an antifriction bearing 12. The outer race 13 of this bearing, e.g. a ball bearing, is connected to a segment-shaped member 18 forming part of the substantially annular unbalanced element 15. The latter comprises a swinging or oscillating mass 19.

Segmental member 18 which forms part of the unbalanced element 15 is further connected to a coupling ring 20 of magnetizable material; this ring has a circular inner surface formed with channel-shaped recesses 22, the equal distances between the centers of adjacent recesses being indicated by letter *t*.

A shaft 26 is located within the unbalanced element 15 and has one of its ends rotatably mounted in the pillar plate 10, its other end being mounted in similar fashion in a bridge 25 which is shown in phantom lines and which is mounted in the non-represented casing of the timepiece. Shaft 26 is connected with a magnet in the form of a discoid follower 28 which latter has a circular peripheral surface formed with alternately arranged unlike poles N, S, as is shown in FIG. 1. The adjacent unlike poles are separated by recesses or cutouts 30, the distance between the centers of adjacent cutouts 30 being the same as that (*t*) between the recesses 22 in the ring 20. The axis of shaft 26 is parallel with the axis about which the element 15 rotates.

The operation of the just described assembly is as follows:

When the user of the timepiece performs movements and the unbalanced element 15 oscillates or is caused to rotate in only one angular direction about its own axis, the follower 28 on shaft 26 always assumes a position in which the resistance offered to the passage of magnetic flux is minimal. Thus, depending on the angular direction in which the annular member 20 of unbalanced element 15 is moved, the follower 28 is caused to rotate clockwise and/or anticlockwise whereby the number of recesses 22 in ring 20 passing along the follower 28 corresponds to the number of unlike poles S, N on the follower which are caused to advance at the same time about the axis of shaft 26. The follower 28 is entrained, i.e. it is caused to rotate with the shaft 26, with a force which corresponds to the strength of the magnetic field generated by the unlike magnets S, N. In the event that the combined force already transmitted to the mainspring by the follower 28 exceeds the strength of said magnetic field, the follower ceases to perform angular movements and the unbalanced element 15 advances along the follower without angularly displacing same.

The transfer of movements performed by the follower 28 to the mainspring of the timepiece in which the assembly of FIGS. 1 and 2 is installed, and more particularly to the housing or casing of said mainspring, can be

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brought about in a number of ways. The movement transferring means or gear train shown in FIGS. 1 and 2 comprises a rocker 41 swingably mounted on a pin 40 carried by the bridge 25 and supporting two meshing gears 42, 43. In the position of FIG. 1, gear 43 meshes with a larger gear 45 which is rigidly and coaxially fixed to the shaft 26 of the follower 28, as well as with an idler or intermediate gear 48 mounted on a shaft 48a, the latter also rigidly supporting a pinion 49 which meshes with and transmits rotation to a second intermediate gear 50 mounted on the shaft 50a. Pinion 50 meshes with a gear 52 fixed to the housing or casing 54 for the non-represented mainspring the inner end of which is connected to the take-off shaft 54a operatively connected with and forming part of the clockwork or watch mechanism. The shaft 54a may transmit motion to the non-illustrated hand or hands of the timepiece in a manner well known in the art. The outer end of the mainspring may be positively and permanently connected with its casing 54. As before stated, the angular movements of follower 28 are terminated by the fully wound mainspring in housing 54 when the resistance of the mainspring to further rotation of member 54 exceeds the strength of the magnetic field existing between the poles of follower 28 and the ring 20. Any subsequent angular movements of the unbalanced element 15 fail to bring about angular displacements of the follower until the energy stored in the mainspring is at least partially dissipated.

If the ring 20 would be replaced by a segmental member, the unbalanced element 15 would bring about rotation of the follower 28 only in certain of its angular positions, i.e. only when the segmental member would pass along the follower. Also, the motion transferring gear train between the follower 28 and the mainspring housing 54 may be replaced by another system, for example, one utilizing ratchet and pawl means, as will be described in connection with FIGS. 3 to 5.

In the embodiment of FIGS. 3 to 5, the pillar plate 60 has a circular peripheral surface connected with the inner race of an antifriction bearing 61. The outer race of the bearing is connected to the inner surface of a ring segment 63 forming part of the automatic winding or unbalanced element 62. The latter, in addition to the ring 63, comprises an oscillatory mass 64 and also carries a composite magnet or coupling means consisting of an annular carrier 65 and two magnetic-pole-forming sheet metal members or plates 66, 67. Carrier 65 is a permanent magnet and is magnetized transversely to its front surfaces. Members 66, 67 are formed with inwardly bent teeth or prongs 66a, 67a, respectively, which alternate and are adjacent to each other, i.e. each tooth 67a of member 67 extends between two spaced teeth 66a of member 66, and vice versa, as is best shown in FIG. 5. The polarity of all teeth 66a on member 66 is the same but unlike that of the teeth 67a on member 67. Thus, the assembly of members 66, 67 comprises a series of pole pairs N, S which form an annulus and cooperate with an oscillatable or rockable follower in the form of a keeper 70 comprising a shaft 71 whose ends are rotatably mounted in pillar plate 60 and bridge 60a, as well as a support or holder 72 formed with two arms each of which supports a magnet 74, 75, respectively. Magnets 74 and 75 are unlike, i.e. of different polarities, and are disposed radially with respect to the inner side of unbalanced element 62. The distance between the magnets 74, 75 equals the distance between the adjacent poles 66a of the member 66 or 67a of the member 67. Support 72 further carries two pawls 78, 79 whose ends engage with the teeth of a ratchet wheel 80 mounted on shaft 80a which latter is rigidly connected with a pinion 82. This pinion meshes with a gear 84 connected to the housing or casing 85 of the mainspring. Housing 85 is rotatable about the axis of a shaft 85a, the latter forming part of the clockwork or watch mechanism to drive the indicating hand or hands of the timepiece in a manner known in the art and forming no part of this invention.

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The assembly of FIGS. 3 to 5 operates as follows:

When the unbalanced element 62 oscillates or rotates about the pillar plate 60, the parts are repeatedly brought into the position shown in FIG. 3 in which the north pole of magnet 74 is located opposite a south pole 66a of annular member 66, and the south pole of magnet 75 is located opposite the adjacent south pole 66a of the same annular member. Magnet 74 is attracted toward the plate-like annular member 66 and the other magnet 75 is repelled by the same annular member. The follower or keeper 70 is thereby rocked about its shaft 71 and the pawl 79 rotates ratchet 80 and, through pinion 82 and gear 84, causes rotation of the casing 85 of the mainspring. As the unbalanced element 62 changes its position, a situation is brought about in which the magnets 74, 75 oppose two north poles 67a of annular member 67. Magnet 75 is then attracted toward the annular member 67 and causes a rocking movement of keeper or follower 70 in anticlockwise direction. Pawl 78 advances the ratchet wheel 80 in anticlockwise direction and, through members 82 and 84, again rotates the housing 85 in the same direction. Such action is repeated until the mainspring is fully wound and its resistance to further rotation of casing 85 by pinion 82 exceeds the strength of the magnetic field existing between the poles 66a, 67a of members 66, 67 and the magnets 74, 75. Shaft 85a is driven by the mainspring in housing 85 and operates the non-represented remaining parts of the clockwork or watch mechanism. Again, the outer end of the mainspring may be permanently connected to the casing 85 since the separation or disconnection of the unbalanced element 62 therefrom occurs between the members 66, 67 and the rockable follower 70.

Referring to FIG. 6, there is shown a further embodiment of my invention which is structurally identical with the embodiment of FIGS. 1-2 and whose elements are identified by reference numerals utilized in the description of FIGS. 1 and 2, each followed by a prime. The sole difference between the embodiments of FIGS. 1-2 and FIG. 6 is that the follower 28' consists of magnetizable material. The unbalanced element 15' of FIG. 6 is a permanent magnet. The winding mechanism of FIG. 6 operates in the same way as the winding mechanism of FIGS. 1-2. The gear train (not shown) which transmits angular movements of the follower 28' to the mainspring is identical with the gear train of FIG. 1.

Without further analysis the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A winding mechanism for self winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction; an angularly movable follower located adjacent to said unbalanced element; means forming a magnetic field between said follower and said unbalanced element whereby the follower is angularly displaced in response to angular movements of the unbalanced element; and means operatively connected with the mainspring and with said follower for transmitting angular movements of the follower to and for winding the mainspring.

2. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction; an angularly movable follower located adjacent to said unbalanced element; means forming a magnetic field between said follower and said unbalanced element whereby the follower is angularly displaced in response to angular movements of the un-

balanced element; and means operatively connected with the mainspring and with said follower for transmitting angular movements of the follower to and for winding the mainspring, the strength of the magnetic field being less than the force with which the fully wound mainspring resists angular movements of the follower whereby the unbalanced element is free to perform angular movements with respect to and without angularly displacing the follower when the mainspring is fully wound.

3. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction; an angularly movable follower located adjacent to said unbalanced element; means on said follower and on said unbalanced element for forming a magnetic field therebetween whereby the follower is angularly displaced in response to angular movements of the unbalanced element, said means comprising at least one magnet on the follower and a member of magnetizable material on said unbalanced element; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

4. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction; an angularly movable follower located adjacent to said unbalanced element; means on said follower and on said unbalanced element for forming a magnetic field therebetween whereby the follower is angularly displaced in response to angular movements of the unbalanced element, said means comprising at least one magnet on the unbalanced element and member of magnetizable material on said follower; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

5. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction; an angularly movable follower located adjacent to said unbalanced element; means on said follower and on said unbalanced element for forming a magnetic field therebetween whereby the follower is angularly displaced in response to angular movements of the unbalanced element, said means comprising at least one magnet on said unbalanced element and on said follower; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

6. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element rotatable about its own axis and comprising an annular member of magnetizable material having a circular inner surface; a discoid follower located within said annular member and angularly movable about its axis which is parallel with the axis of said unbalanced element, said follower having a circular peripheral zone formed with at least one pair of unlike magnetic poles turned toward the surface of said annular member whereby a magnetic field is formed between said poles and the annular member and the follower is angularly displaced when the unbalanced element rotates; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

7. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination:

an unbalanced element rotatable about its own axis and comprising an annular member of magnetizable material having a circular inner surface; a discoid follower located within said annular member and angularly movable about its axis which is parallel with the axis of said unbalanced element, said follower having a circular peripheral zone formed with a plurality of alternately arranged unlike magnetic poles turned toward the surface of said annular member whereby a magnetic field is formed between said poles and the annular member and the follower is angularly displaced when the unbalanced element rotates; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

8. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element rotatable about its own axis and comprising a member of magnetizable material having an arcuate inner surface; a follower located within said annular member and angularly movable about an axis parallel with the axis of said unbalanced element, said follower comprising at least one magnet having a pair of unlike poles turned toward the surface of said annular member whereby a magnetic field is formed between said poles and the annular member and the follower is angularly displaced when the unbalanced element rotates; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

9. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising an annular member of magnetizable material, the annular member having an inner surface formed with equally spaced recesses defining therebetween pronounced magnetic poles; a follower located within said annular member and angularly movable about an axis parallel with the axis of said unbalanced element, the follower having a circular peripheral zone constituting a magnet and formed with a plurality of equally spaced recesses which define pronounced alternating unlike magnetic poles therebetween whereby a magnetic field is formed between the poles of said follower and the adjacent poles of said annular member and the follower is angularly displaced in response to angular displacements of the unbalanced element; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

10. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising an annular member of magnetizable material, the annular member having an inner surface formed with equally spaced recesses defining therebetween pronounced magnetic poles; a follower located within said annular member and angularly movable about an axis parallel with the axis of said unbalanced element, the follower having a circular peripheral zone constituting a magnet and formed with a plurality of equally spaced recesses which define pronounced alternating unlike magnetic poles therebetween whereby a magnetic field is formed between the poles of said follower and the adjacent poles of said annular member and the follower is angularly displaced in response to angular displacements of the unbalanced element, the distance between the recesses in said annular member being equal to the distance between the recesses in the peripheral zone of said follower; a rotatable casing connected with the mainspring for winding same; and means operatively connected

with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

11. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising an annular member of magnetizable material, the annular member having an inner surface formed with equally spaced recesses defining therebetween pronounced magnetic poles; a follower located within said annular member and angularly movable about an axis parallel with the axis of said unbalanced element, the follower having a circular peripheral zone constituting a magnet and formed with a plurality of equally spaced recesses which define pronounced alternating unlike magnetic poles therebetween whereby a magnetic field is formed between the poles of said follower and the adjacent poles of said annular member and the follower is angularly displaced in response to angular displacements of the unbalanced element; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring, the strength of said magnetic field being less than the force with which the fully wound mainspring resists rotation of the casing whereby the unbalanced element is free to perform angular movements with respect to and without angularly displacing the follower when the mainspring is fully wound.

12. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising magnet means defining a plurality of annularly disposed alternately arranged unlike poles; an angularly movable follower located within said magnet means and comprising at least one pair of magnets whereby a magnetic field is formed between the magnets of said follower and the poles of said magnet means and the follower is angularly displaced in response to angular movements of the unbalanced element, the distance between the magnets of each pair of magnets on said follower being equal to the distance between adjacent like poles of said magnet means; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

13. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising magnet means defining a plurality of annularly disposed alternately arranged unlike poles; a rockable keeper located within said magnet means adjacent to said unbalanced element and comprising two arms; a pair of magnets, each connected to one of said arms whereby a magnetic field is formed between the magnets of said keeper and the poles of said magnet means and the keeper is rocked in response to angular movements of the unbalanced element; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the keeper for transmitting rocking movements of the keeper to said casing whereby the latter winds the mainspring.

14. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising magnet means defining a plurality of annularly disposed alternately arranged unlike poles; an angularly movable follower located within said magnet

means adjacent to said unbalanced element and comprising at least one pair of magnets whereby a magnetic field is formed between the magnets of said follower and the poles of said magnet means and the follower is angularly displaced in response to angular movements of the unbalanced element; a rotatable casing connected with the mainspring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring, the strength of the magnetic field between the magnets of said follower and said magnet means being less than the force with which the fully wound mainspring resists rotation of the casing whereby the unbalanced element is free to perform angular movements with respect to and without angularly displacing the follower when the mainspring is fully wound.

15. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element angularly movable about its axis and comprising magnet means including an annular magnet and a pair of annular plate like members adjacent to the annular magnet and each formed with a plurality of teeth, the teeth of said annular members being of unlike polarities and alternating with each other to form an annulus; an angularly movable follower located within said annulus adjacent to said unbalanced element and comprising at least one pair of magnets whereby a magnetic field is formed between the magnets of said follower and said teeth and the follower is angularly displaced in response to angular movements of the unbalanced element; a rotatable casing connected with the main spring for winding same; and means operatively connected with the casing and with the follower for transmitting angular movements of the follower to said casing whereby the latter winds the mainspring.

16. A winding mechanism for self-winding timepieces having a mainspring which comprises, in combination: an unbalanced element mounted for angular movements in at least one direction, at least a portion of said element being of magnetizable material; a rotatable casing connected with the mainspring for winding same; an angularly movable follower having at least one pair of unlike magnetic poles and located adjacent to said element whereby a magnetic field is formed between said follower and said unbalanced element and the follower is angularly displaced in response to angular movements of the unbalanced element; and means operatively connected with said casing and with said follower for transmitting angular movements of the follower to said casing whereby the latter winds said mainspring, the strength of the magnetic field between said follower and said unbalanced element being less than the force with which the fully wound mainspring resists rotation of the casing whereby the unbalanced element is free to perform angular movements with respect to and without angularly displacing the follower when the mainspring is fully wound.

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