May 20, 1941. W. E. MAXWELL 2,242,654

IMPULSE TIMEPIECE

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Fig. 1.

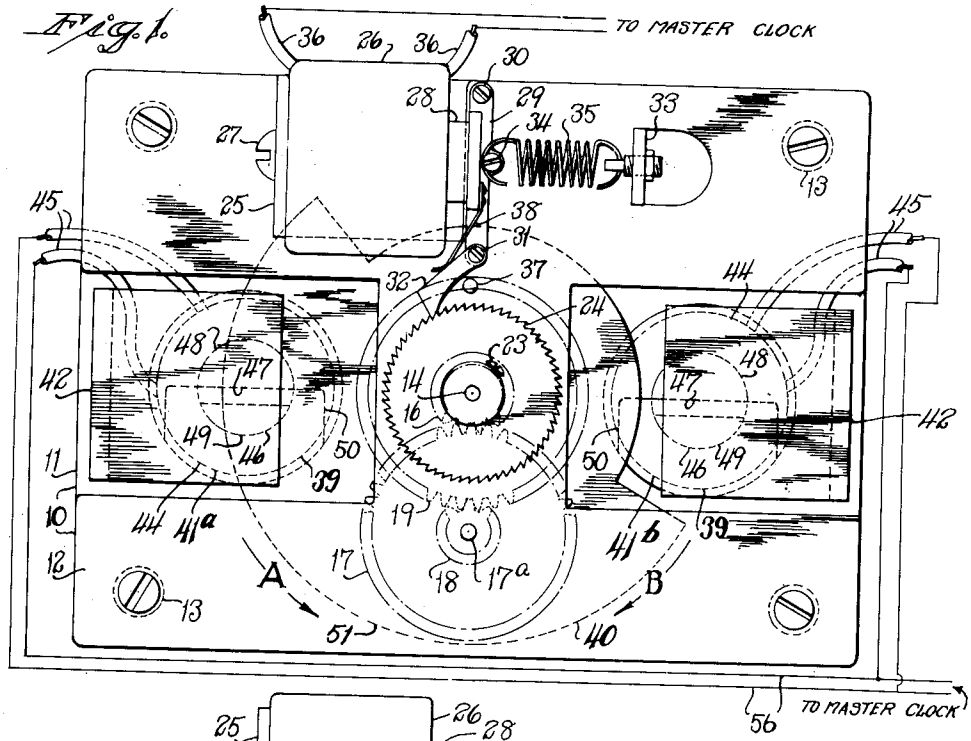

Fig. 2.

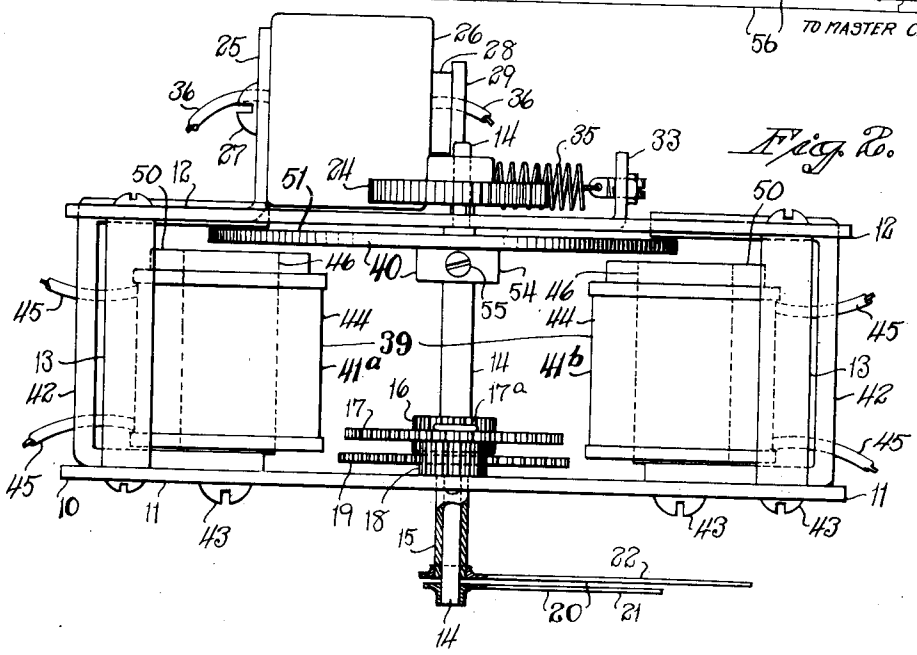

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Fig. 3.

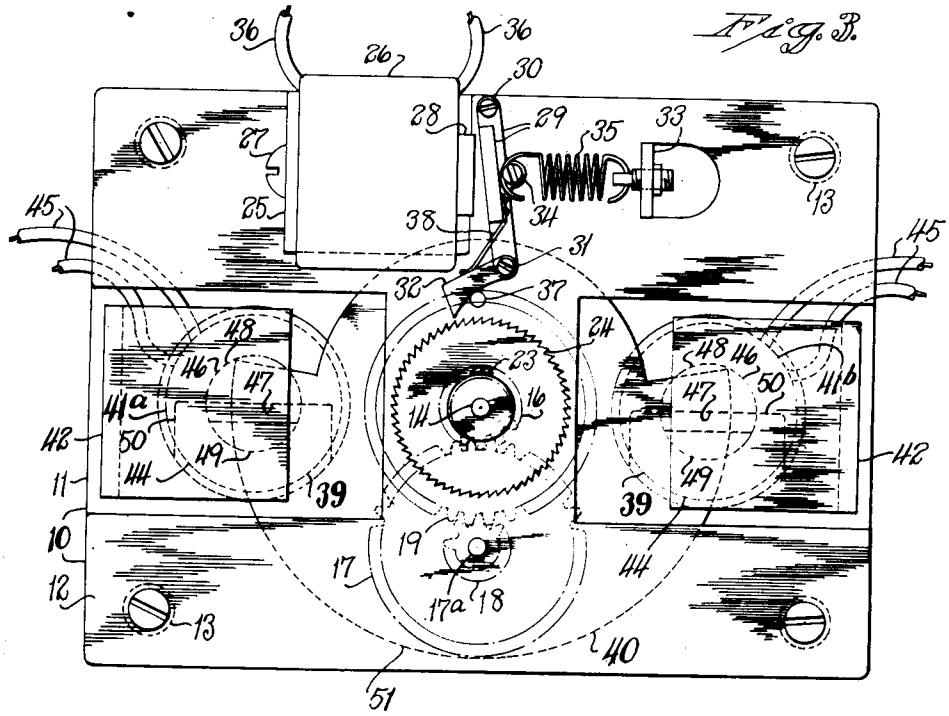
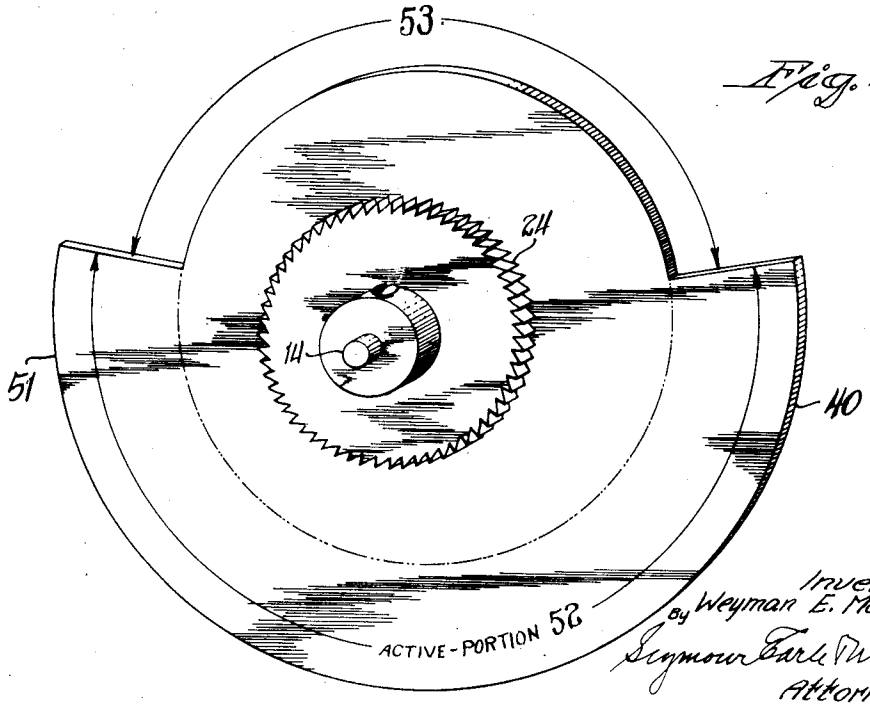


Fig. 4.



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Patented May 20, 1941 2,242,654

UNITED STATES PATENT OFFICE

2,242,654

IMPULSE TIMEPIECE

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Application April 13, 1939, Serial No. 267,633

10 Claims. (Cl. 58—34)

The present invention relates to improvements in resetting devices for impulse-timepieces, and more especially to resetting devices of this character for synchronizing the hands or equivalent of any desired number of secondary timepieces operated under the remote unitary control of a master clock or the like.

One object of this invention is to provide a superior resetting device of improved construction by means of which the time-indicating means of several secondary timepieces may be reset and synchronized under remote unitary control in a more accurate and effective manner than heretofore.

A further object of the present invention is to provide superior resetting means for impulse clocks and characterized by minimum noise and shock combined with surety of operation.

Another object of the present invention is to provide a resetting device of superior form and construction in which the resetting impulses are transmitted to the hour-hand and minute-hand or the like of a secondary timepiece, by means of a rotary armature which moves in synchronism with the said hands and which, at the same time, is electromagnetically responsive to the resetting impulses.

In connection with the foregoing objects, a still further object of the invention is to provide a superior resetting device of this character which utilizes an electromagnetically-operated armature movable in synchronism with the hands or equivalent of the timepiece to avoid, in large measure, the use of gearing with its accompanying noise; consequent wear and tear; and complicated field-structures for controlling the resetting operation.

Another object of the invention is to provide a resetting device of superior construction comprising a relatively-small number of parts of simple and effective form which render the device reliable in operation and comparatively immune to the necessity for frequent or extensive repairs.

A still further object of the invention is to provide a superior form and construction for resetting devices in which the resetting impulses are transmitted to the hands of a secondary timepiece by means of a rotary armature which, during the transmission of the resetting impulses, is continuously under the constraint of two opposed electromagnetic forces in such a way that the rotational effects of each upon the rotary armature depend upon the rotational position of said rotary armature with respect to the electro-responsive devices which produce the electromagnetic forces to thereby render one or the other of said electromagnetic forces predominant for resetting the hands of the timepiece.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art.

In the accompanying drawings, in which one mode of carrying out the present invention is shown for illustrative purposes:

Fig. 1 is a view in rear elevation of an impulse timepiece movement embodying the present invention;

Fig. 2 is a bottom plan view of the same, partly in section;

Fig. 3 is a view in rear elevation similar to Fig. 1, with the parts shown in changed positions; and

Fig. 4 is an enlarged rear perspective view of the unit comprising the rotary armature, the center-arbor and the ratchet-wheel by means of which the center-arbor may be normally driven.

According to the embodied form of the invention shown on the drawings for purposes of illustration, the impulse time-movement is provided with a movement-frame which is generally designated by the reference character **10**. The movement-frame **10** comprises a front movement-plate **11**, a back movement-plate **12**, and pillars **13** interposed between and rigidly connected to the said front and back movement-plates **11** and **12**.

Extending through the front and back movement-plates **11** and **12**, is a center- or minute-arbor **14** on the forward portion of which an hour-hand sleeve **15** is mounted with freedom for relative rotation. Rigidly mounted upon the center-arbor **14** adjacent to the rear face of the front movement-plate **11**, is a minute-pinion **16** which meshes into and drives a dial-wheel **17** freely journaled on a stud **17a** extending rearwardly from the front movement-plate **11**. Rigid with the dial-wheel **17** is a dial-pinion **18** which meshes into and drives an hour-wheel **19** carrying the hour-hand sleeve **15** before referred to.

As shown in Fig. 2, a time-pointer set which is generally designated by the reference character **20** comprises a minute-hand **21** secured to the forward end of the center-arbor **14** and an hour-hand **22** which is secured to the hour-hand sleeve **15**.

Secured to the center-arbor **14** at the rear of

the back movement-plate 12, by means of a set-screw 23, is a ratchet-wheel 24 having sixty teeth. Projecting rearwardly from the back movement-plate 12 above the ratchet-wheel 24, is an arm 25 which carries an electromagnet 26. The said electromagnet is secured to the arm 25 by means of a screw 27 which is threaded into the core structure 28 of the said electromagnet 26. As shown particularly well in Figs. 1 and 3, the electromagnet 26 is provided with an armature 29 which is pivotally mounted upon a stud 30 which projects rearwardly from the back movement-plate 12. Pivotally mounted upon a pin 31 in the free end of the armature 29 is a pawl 32 which is movable into and out of driving engagement with the ratchet-wheel 24 before referred to.

Interposed between an arm 33 extending rearwardly from the back movement-plate 12, and the armature 29, is a tension-spring 35. The said tension-spring 35 is anchored at one end in the fixed bracket 33 and has its other end connected at 34 to the armature 29. The electromagnet 26 is connected through terminal wires 36 with a source of periodic electrical impulses such, for example, as a master clock (not shown). Arranged below the pawl 32 is a pawl-retiring pin 37 against which the pawl 32 is pressed in the retracted position of the armature 29, by a sheet-metal spring 38.

It will be understood from the foregoing that at each energization of the magnet 26, the armature 29 is moved toward the left as viewed in the drawing, to move the pawl 32 forwardly and downwardly into engagement with the ratchet-wheel 24 to advance the latter a distance of one tooth and thereby transmit a movement equivalent to one minute, to the time-pointer set 20 as is shown in Fig. 1. As the magnet 26 becomes deenergized, the tension-spring 35 will retract the armature 29 which, in turn, will retract the pawl 32 and cause the same to ride upwardly over the pin 37, whereby it is disengaged from the ratchet-wheel 24 as indicated in Fig. 3.

Disposed between the front and back movement-plates 11 and 12 of the movement-frame 10 is an eddy-current motor-structure comprising a field-structure generally designated by the reference character 39, and a rotary armature generally designated by the reference character 40.

The field-structure 39, in the embodied form of the invention shown on the drawings, comprises two oppositely-arranged field-magnets which are respectively generally designated by the reference characters 41*a* and 41*b*. Each of the said field-magnets is mounted between the front and back movement-plates 11 and 12 of the movement-frame 10 within a U-shaped magnet-yoke 42 formed of iron or the like and secured in place by a screw 43 extending through the front movement-plate 11.

Each of the field-magnets 41*a* and 41*b* comprises an energizing-coil 44 having lead-wires 45, and a pole-piece 46 formed of magnetic material and provided at its rear end with a transverse slot 47. The rear end of each pole-piece 46 terminates sufficiently short of the rear arm of its complemental magnet-yoke 42 to provide a sufficient space to accommodate the before mentioned rotary armature 40.

The transverse slot 47 in the rear end of each pole-piece 46 provides the same with upper and lower salient-poles 48 and 49. The lower salient-pole 49 of each pole-piece 46 is encircled by a shading-coil 50 formed of copper or the like and serving in conjunction with its complemental upper salient-pole 48 (which is unshaded) to produce a "rotating field" effect tending to turn the rotary armature 40 in the manner as will be hereinafter pointed out.

As shown, the rotary armature 40 includes a disk 51 formed of aluminum or other suitable material providing eddy-currents in response to the action of the field-magnets 41*a* and 41*b*, and having a segmental peripheral active-portion 52 extending continuously somewhat more than halfway around the periphery of the said disk in position to turn into registration with the rear ends of the pole-pieces 46 of the respective field-magnets 41*a* and 41*b*. As thus constructed the disk 51 has a notch or gap 53 in its periphery so that at certain portions of its turning movement, the said disk will be unaffected by one or the other of the field-magnets 41*a* and 41*b*.

In addition to the disk 51, the rotary armature 40 includes a hub 54 centrally secured to the said disk 51 and in turn rigidly attached to the center- or minute-arbor 14 by means of a set screw 55.

The field-magnets 41*a* and 41*b* are both connected to a pair of wires 56—56 to be simultaneously energized by resetting impulses sent out by a master clock or the like located at a remote station and under these conditions, to create two electromagnetic forces which respectively generate oppositely directed rotating field-effects tending to turn the rotary armature 40 in opposite directions under conditions as will hereinafter appear. Moreover, these opposed rotating field-effects are adapted to counterbalance each other in a predetermined centralized position of the outer active-portion 52 of the disk 51 of the rotary armature as will also hereinafter appear.

For the purpose of making clear the operation of the secondary impulse-timepiece herein chosen for illustration of the present invention, let it be assumed that the time-magnet 26 is being energized by the master clock at uniform minute-intervals, so as to cause the pawl 32 to turn the ratchet-wheel 24 a distance equal to one tooth for each impulse so received by the said time-magnet. In this manner, the center-arbor 14 will be turned in step-by-step movement, as will also the rotary armature 40 carried thereby. The step-by-step turning of the center-arbor 14 will also advance the time-pointer set 20 one minute of time-indicating distance.

It occasionally happens that the master clock sends out impulses at more frequent intervals than those intended, so that the secondary impulse-timepiece may be "fast." It also occasionally happens that the master clock may fail to send out impulses to the time-magnet 26 at each of the desired minute-intervals and, in this latter case, the clock will, of course, depart from correct time and be "slow."

It is for the purpose of periodically correcting the possible happenings or failures above referred to that there is provided an eddy-current or induction-motor, as above described.

For the purpose of making clear the operation of the resetting or corrective feature of the clock illustrated, let it be assumed that the master clock has failed to consistently supply electrical impulses to the time-magnet 26 and that, therefore, the clock is slow. Under these conditions, for instance, the rotary armature 40 may occupy, on the even hour, the position in which it is indicated in Fig. 1, whereas, at this time it should

occupy the position in which it is shown in Fig. 3. It will be understood in this connection that the rotary armature **40** moves with the center-arbor **14** and hence with the minute-hand **21** and, therefore, turns normally under the urge of the time-magnet **26** at a rate of one revolution per hour composed of sixty step-by-step movements.

With the clock slow, as above described, let it be assumed that the master clock sends out a corrective impulse through the wires **56—56** to simultaneously energize both of the field-magnets **41***a* and **41***b* at the even hour. Under these conditions, the field-magnet **41***b* will have no effect for the time being upon the rotary armature **40** for the reason that the active-portion **52** of the latter will be out of registration with the said field-magnet. At this time, however, the said active-portion **52** of the rotary armature **40** will be in registration with the field-magnet **41***a*, so that the latter field-magnet will slowly but surely turn the rotary armature in the direction of the arrow A in Fig. 1. In a very short time, the said rotary armature **40** will have been turned sufficiently to bring its active-portion **52** into the field of the field-magnet **41***b*, which will, of course, exert an effort to turn the rotary armature in the direction of the arrow B of Fig. 1. Owing to the fact, however, that at this time the active-portion **52** of the rotary armature **40** will have a greater area exposed to the action of the field-magnet **41***a*, the force of the said field-magnet will at this time overpower the counter effort of the field-magnet **41***b* until the force exerted by the respective field-magnets counterbalance each other in their respective opposing effects when the active-portion **52** of the rotary armature **40** becomes centralized, as illustrated in Fig. 3.

The minute-hand **21** is so oriented with respect to the rotary armature **40** that when the said armature is in the position in which it is shown in Fig. 3, the minute-pointer **21** will register with the usual numeral "12" on the dial of the time-piece. During the turning movement of the rotary armature as described, it will be appreciated that the pawl **32** is in its retired position, as indicated in Fig. 3.

In contrast to the brief duration of the impulses supplied to the time-magnet **26**, which impulses may be of but a fraction of a second's duration each, the duration of the hourly corrective impulses supplied by the master clock concurrently to both of the field-magnets **41***a* and **41***b*, is of relatively-long duration and may, for instance, be four or five seconds in extent, depending upon the responsiveness of the particular eddy-current or equivalent motor embodied in the particular clock under consideration. In any event, it is preferred that the responsiveness of the eddy-current or induction-motor be sufficiently slow as not to cause undue noise or shock to the mechanism.

It will be appreciated from the foregoing that if at the time that the master clock simultaneously energizes both of the field-magnets **41***a* and **41***b* (preferably on each even hour), the clock should be fast, the rotary armature **40** will be turned in a reverse direction from that previously described, until the effectiveness of both of the said field-magnets upon the rotary armature **40** is equalized, as before described, whereupon the clock will have been restored or reset to a position to indicate the even hour.

After the resetting operation, and regardless of the direction in which the same occurred, the master clock will resume the once-a-minute energization of the time-magnet **26**, and the time-piece will resume its normal step-by-step functioning, to be again corrected, if in error, on the next-succeeding even hour, or at such other intervals as may be provided for.

A resetting device for impulse-timepiece movements of the character contemplated by the present invention may be operated by recurring pulsating currents or by alternating currents of commercial frequencies such, for example, as 25, 50 and 60 cycle currents which may be, preferably, reduced to 24 volts.

The use of a motor-structure of the eddy-current type conduces to the production of a comparatively-inexpensive device which is reliable in operation and comprises a relatively-small number of parts of simple and effective form. Said device may be employed with various forms of impulse driving-mechanisms to provide for the resetting of the hour- and minute-hands, or their equivalents, at predetermined time-intervals.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. A resetting device for the time-indicator of a secondary impulse-timepiece movement, comprising: a time-indicator; a rotary armature connected to said time-indicator for intermittent rotational operation; and a field-structure energizable at any intermittent rest period of the said intermittently-rotated armature to control the same with respect to its rotation at any position of the said armature, the said field-structure including two electro-responsive devices to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature to turn the same in opposite directions respectively, and to balance each other in respect to their electromagnetic effects on the said rotary armature when the latter, and hence the said time-indicator connected thereto, is in a predetermined reset position.

2. A resetting device for the time-indicator of a secondary impulse-timepiece movement, comprising: a time-indicator; a rotary armature connected to said time-indicator for intermittent rotational operation; and a field-structure energizable at any intermittent rest period of the said intermittently-rotated armature to control the same with respect to its rotation at any position of the said armature, the said field-structure including two electro-responsive devices to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature to turn the same in opposite directions respectively, and to counterbalance each other in respect to their electromagnetic effects on said rotary armature in a predetermined central position of the rotary armature with respect to said electro-responsive devices.

3. A resetting device for the time-indicator of a secondary impulse-timepiece movement, comprising: a time-indicator; a rotary armature connected to said time-indicator for intermittent

rotational operation; and a field-structure energizable at any intermittent rest period of the said intermittently-rotated armature to control the same with respect to its rotation at any position of the said armature, the said field-structure including two electro-responsive devices to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature to turn the same in opposite directions respectively, and to counterbalance each other in respect to their electromagnetic effects on said rotary armature in a predetermined central position of the rotary armature with respect to said electro-responsive devices; said rotary armature being constructed and arranged with respect to the electro-responsive devices to vary the relative electromagnetic effects of said devices on the rotary armature to correspond with the magnitude and direction of the latter's displacement from said predetermined central position.

4. A secondary impulse-timepiece movement, including: a time-indicator; means for transmitting periodic impulses to said time-indicator; and means for resetting the time-indicator at predetermined intervals of time; said means for resetting the time-indicator comprising: a rotary armature having an operating-connection with said time-indicator to be moved in synchronism therewith and to impart resetting movements thereto; and a field-structure energizable to control the said rotary armature with respect to its rotation at any position of the said armature, the said field-structure including two electromagnetic field-windings to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature to turn the same in opposite directions, respectively, in variable degree, depending upon the rotational displacement of said armature from a predetermined reset position in which the electromagnetic effects of said field-windings on the armature are counterbalanced.

5. A secondary impulse-timepiece movement, including: a time-indicator; means for transmitting periodic impulses to said time-indicator; and means for resetting the time-indicator at predetermined intervals of time; said means for resetting the time-indicator comprising: a rotary armature having an operating-connection with said time-indicator to be moved in synchronism therewith and to impart resetting movements thereto; and a field-structure energizable to control the said rotary armature with respect to its rotation at any position of the said armature, the said field-structure including two electromagnetic field-windings to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature in opposition to each other; said rotary armature being constructed to vary the relative rotary field-effects of said field-windings thereon to correspond to its displacement from a predetermined position of the armature in which said rotary field-effects are counterbalanced in the reset position of the time-indicator.

6. A secondary impulse-timepiece movement, including: a time-pointer set; a center-arbor connected to said time-pointer set; means for imparting the normal timing-impulses to said center-arbor; a rotary armature connected to said center-arbor to be moved in synchronism with the time-pointer set and to impart resetting movements thereto; and a field-structure energizable to control the said rotary armature with respect to its rotation at any position of the said armature, said field-structure comprising two electromagnets arranged on opposite sides of the rotary axis of said armature to operate by magnetic induction on the said rotary armature and including means to produce opposed rotary field-effects in the armature to turn the same in opposite directions, respectively; the construction and arrangement of the rotary armature being such that the rotary field-effects on the armature during the transmission of resetting impulses thereto, operate to move the rotary armature into, and to stabilize it in, a position corresponding to a predetermined reset position of the time-pointer set.

7. A secondary impulse-timepiece movement, comprising: time-indicating mechanism having a center-arbor, a minute-hand mounted on said center-arbor and an hour-hand geared to said center-arbor; a rotary armature mounted on and rotatable with said center-arbor; two electromagnets having pole-pieces arranged adjacent to said armature on opposite sides of said center-arbor and comprising split salient poles; said rotary armature having an arcuate marginal portion thereof removed to form a gap extending between and centrally interposed with respect to said electromagnets when the hour- and minute-hands are in predetermined reset positions; mechanism detachably connected to said center-arbor for transmitting the normal timing-impulses thereto; and shading-coils mounted on rotationally-adjacent salient poles of both electromagnets to produce opposed rotary field-effects in the rotary armature to counterbalance the rotary armature when said hour- and minute-hands are in said predetermined reset-positions.

8. In combination with the center-arbor and the time-pointer set of a secondary impulse-timepiece movement; a motor-structure of the eddy-current type energizable at the ends of predetermined time-intervals for transmitting resetting impulses to said center-arbor, comprising: a rotary armature connected to said center-arbor to occupy a predetermined rotational position when the said time-pointer set is in any one of a plurality of predetermined reset-positions; and two field-magnets constructed and arranged to produce opposed rotary field-effects for rotationally displacing said rotary armature to its said predetermined rotational position whenever the time-pointer set is not in one of its predetermined reset-positions at the end of one of said predetermined time-intervals.

9. A resetting device for secondary impulse-timepiece movements, comprising in combination with electromagnetic-means for transmitting normal actuating-impulses to the timepiece movement; a center-arbor for transmitting the said normal actuating-impulses to the hour- and minute-hands of the timepiece movement; a releasable operating-connection between said electromagnetic-means and said center-arbor; and a motor-structure of the eddy-current type, comprising: a rotary armature secured to said center-arbor; and two field-windings constructed and arranged to produce eddy-currents in the rotary armature and to be electromagnetically reacted upon by said eddy-currents to produce two opposing electromagnetic forces on said armature to turn said armature in opposite di-

rections, respectively, said armature being shaped and arranged with respect to said field-windings to effect a counterbalance of the rotary field-effects thereon when the said armature is in a rotational position corresponding to the predetermined reset-positions of said hour- and minute-hands.

10. A resetting device for secondary impulse-timepiece movements, comprising in combination with an arbor movable in synchronism with the hour- and minute-hands of an impulse-timepiece: a motor-structure of the eddy-current type for transmitting resetting impulses to said arbor, said motor-structure comprising: a rotary armature secured to said center-arbor; and two electro field-magnets constructed and arranged to produce counteracting rotary field-effects on said armature to turn the same in opposite directions, respectively; the said rotary armature being shaped to vary the relative values of the said rotary field-effects of said electro field-magnets thereon, depending upon the relative displacement of the rotary armature with respect to the field-magnets and to counterbalance said rotary field-effects when the hour- and minute-hands are in predetermined reset-positions.

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