

Dec. 3, 1935.

W. DUBILIER

2,023,355

ELECTROMAGNETIC OPERATING MECHANISM

Filed May 2, 1930

2 Sheets-Sheet 1

Fig. 1

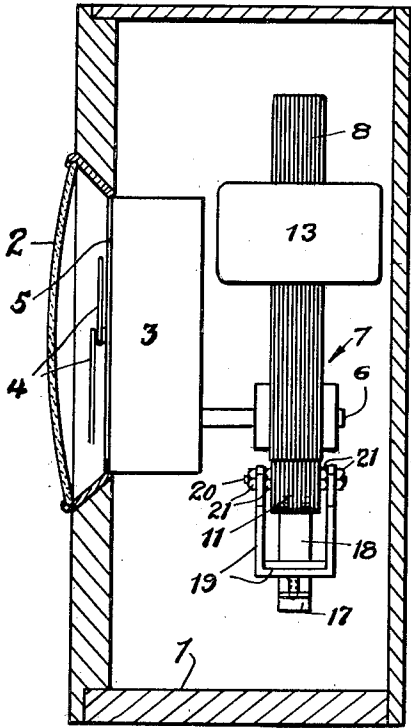


Fig. 2

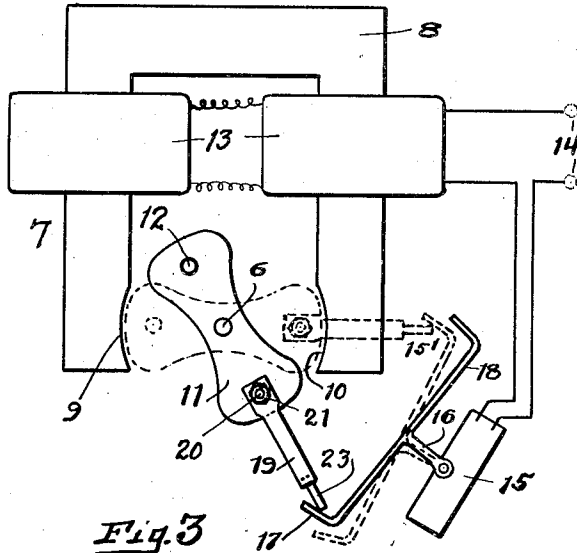


Fig. 3

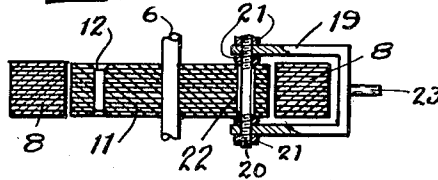


Fig. 4

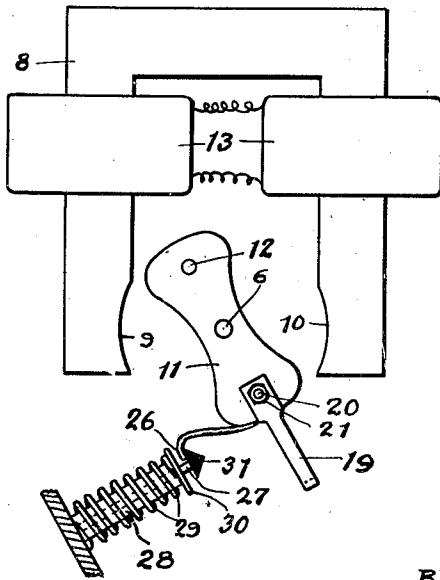
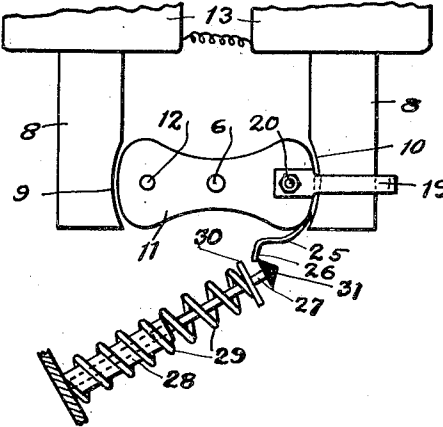


Fig. 5



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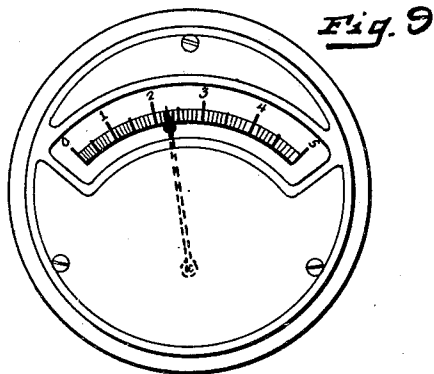
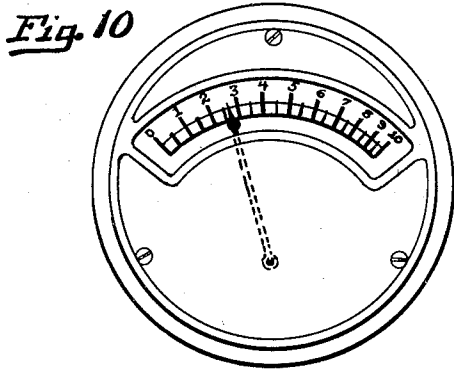
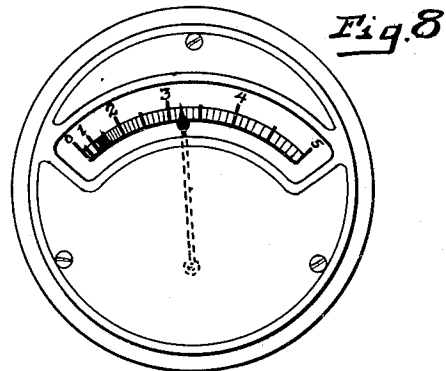
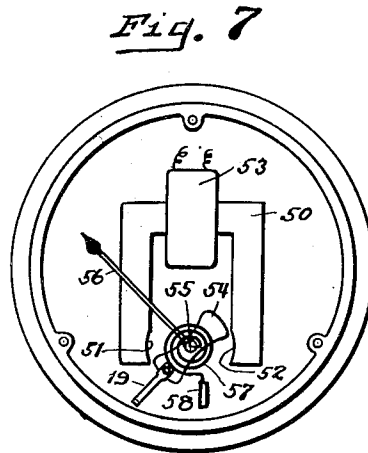
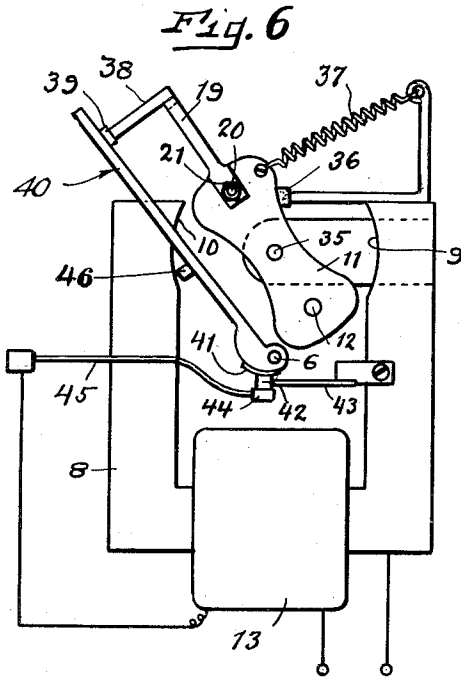
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ELECTROMAGNETIC OPERATING MECHANISM

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2 Sheets-Sheet 2



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ELECTROMAGNETIC OPERATING MECHANISM

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Application May 2, 1930, Serial No. 449,213

9 Claims. (Cl. 185—40)

My invention relates to electric control devices and more particularly to devices for controlling the movement of members that are operated by electrical means.

My invention has utility in such apparatus as electric clocks, electrical indicating instruments, electric typewriters, electric selective indicators, etc.

There are many devices in which the movement of a rotatably or rockably mounted armature is utilized to perform a definite function. I have discovered that the rotating or rocking movement of the armature may be advantageously applied to the automatic winding of an electric clock.

Accordingly, one object of my invention is to provide novel means for applying the rocking movement of an armature to the spring of a clock for automatically winding this spring when it has run down a pre-determined amount.

In devices which utilize the movement of an armature for operating purposes, difficulties have been experienced due to the fact that the armature and other movable parts, in coming to rest, are subject to considerable mechanical shock, resulting not only in injury to the movable parts, but also in undesirable noises. This difficulty is particularly undesirable in electric clocks, which are usually intended for domestic and office use, where silence is quite essential.

A further object of my invention is to provide novel means for controlling the movement of the armature to bring it to rest with the least possible mechanical shock and noise.

A further object of my invention is to provide novel means whereby a rapid movement of the armature is effected at the beginning of the winding stroke and a rapid deceleration is effected near the end of the stroke.

Another object of my invention is to provide novel switching means for controlling the winding of an electric clock.

A further object of my invention is to provide novel means in an electric clock for damping the motion of a rocking armature.

Heretofore, due to the inherent characteristics of the instruments, some types of electric meters and particularly alternating current meters, have been so calibrated that the values are widely separated near the beginning of the movement of the meter and crowded near the end of its motion. This renders the reading of meters difficult.

Accordingly, a further object of my invention is to provide novel means for spreading the cali-

brations of an electric instrument to render it more uniform over the reading scale.

Still a further object of my invention is to provide means controlled by the magnetic field which operates the instrument to modify the action of the field on the main part of the instrument.

Other objects will become apparent from the following description, taken in connection with the accompanying drawings, in which,

Figure 1 is a sectional elevation through an electric clock winding mechanism to which my invention has been applied.

Figure 2 is a diagrammatic illustration of the clock winding mechanism, showing the control loop and the switching mechanism.

Figure 3 is a fragmentary sectional view, illustrating the manner of mounting the control loop on the armature.

Figure 4 is a fragmentary view, illustrating a modification of the switching mechanism shown in Figure 2.

Figure 5 is a view, similar to Figure 4, showing the parts in a different operating position.

Figure 6 is a diagrammatic illustration of the clock winding mechanism, showing a further modification of the switching mechanism.

Figure 7 is a diagrammatic view of an ammeter equipped with a control loop, in accordance with my invention.

Figure 8 shows a standard scale arrangement of an ammeter.

Figure 9 shows an ammeter scale, as modified from Figure 8 by the improvement of my invention.

Figure 10 is another ammeter scale, in which the range has been widened by the application of my invention.

Similar reference numerals refer to similar parts throughout the several views.

Referring to Figure 1, the electric clock, to which my invention has been applied herein, for purposes of illustration, comprises a casing 1, provided at its front with a glass cover 2 and containing a clock mechanism 3 for driving the clock hands 4 over the clock face 5. The clock mechanism 3 is provided with the usual winding spindle 6, which may be operated to wind the main spring of the clock mechanism. The casing 1 also contains an electromagnetic mechanism 7 for operating the spindle 6, to wind the main spring of the clock mechanism when such spring has unwound a predetermined extent, as will be described hereinafter.

As shown in Figure 2, the electromagnetic

winding mechanism comprises a laminated iron yoke 8, having shaped pole pieces 9 and 10 and an armature 11 secured to the winding spindle 6. The armature may consist of a plurality of laminated punchings held together by rivets 12.

The yoke 8 may be provided with one or more coils, such as 13, connected in an electric circuit, which comprises a direct current or alternating current source 14 and a switch 15. Inasmuch as the specific details of the switch 15 form no part of my present invention, I have illustrated it diagrammatically. However, the switch 15 should, preferably, be of the snap-acting type and provided with an operating arm 16 having extensions 17 and 18.

Secured to the armature 11 and extending outwardly therefrom is a loop 19 of conducting material. As shown in Figure 3, the loop 19 may be approximately rectangular in shape. It may be secured to the armature by means of a bolt 20 and nuts 21, the bolt extending through a hole 22 in the armature. The loop 19 is provided with an extension 23 for operating the snap switch 15.

The operation of this form of my invention is as follows:

When the clock spring is fully wound, the armature 11 occupies the position shown by dotted lines in Figure 2 and, as the clock spring unwinds, the armature rotates clockwise until it occupies the position shown by full lines. At this point in the unwinding movement of the spring, the extension 23 on the loop 19 engages the extension 17 of the switch operating arm 16 and snaps this arm with its extensions 17 and 18 into the position shown by dotted lines, thereby closing the switch 15 and energizing the magnet coil 13. Energization of magnet coil 13 rocks the armature 11 from the full line position to the dotted line position, thereby winding the clock spring. At the end of this movement, the extension 23 on the loop 19 engages the extension 18 of the switch operating arm 16 and rocks the arm with its extensions back to the full line position, thereby opening the switch 15 and de-energizing the magnet coil 13. During the counterclockwise or spring winding movement of the armature, the loop 19 encircles the pole piece 10 and has induced in it a current, by the action of the electromagnetic field, of such a magnitude and phase as to oppose the movement and act as a braking force. In particular, with direct current excitation the loop will act as a magnetic damper, due to its entrance into the magnetic field, while with alternating current it will have induced in it by transformer action an alternating current of a phase opposing the phase of the magnet coil 13 and resulting in a strong repulsion between the coil 13 and loop 19, as is well known. In other words, the loop will have a tendency to seek the weaker part of the field, while the attraction of the armature tends to place it under a stronger action of the field.

In the modified switching arrangement shown in Figures 4 and 5, the armature carries a thin spring 25, which is provided with a contact surface 26 for cooperation with a contact rod 27 when the armature 11 reaches the unwound position, as shown in Figure 4. The rod 27 is guided in a tube 28, suitably fixed to the casing of the clock. The tube 28 is surrounded by a spring 29, one end of which is secured to the casing and the other end of which is secured to a washer 30, which is, in turn, secured to the rod 27.

As the armature rocks in a counterclockwise direction, the spring 25 engages an insulating

button 31, mounted on the end of the rod 27 and drags this rod along against the tension of the spring 29. Figure 5 shows the position of the armature and the spring in the wound relation, just when the spring 25 is about to slip off the button 31 on the rod 27, as a result of the linear movement of the rod 27 and the rocking movement of armature 11. As soon as the spring 25 releases the button 31, spring 29 restores the rod 27 to its original position in the tube 28; namely, the position shown in Figure 4. Excessive movement of the rod 27 is prevented by the washer 30. It will be seen that the armature 11 is permitted to rock through a considerable angle, while the current is on, thus winding the spring of the clock, while further movement of the armature is prevented, as before, by the braking action of the loop 19 and also by the resistance of the wound clock spring.

The return of the armature in each case is prevented by the usual ratchet arrangement on the clock spring, until the movement of the hands of the clock bring the winding spindle 6 and the armature 11 to the unwound position.

In the embodiment of my invention, illustrated in Figure 6, the same parts of the winding mechanism are utilized, but the clock spindle and the armature spindle are separate elements. In this embodiment of my invention, the armature 11 is mounted on a spindle 35 and is normally maintained in engagement with a resilient stop 36, by means of a spring 37 secured to one of the pole pieces of the yoke 8. The loop 19 carries an angular extension 38, the outer end of which is provided with a contact point 39 for engaging a lever 40 secured to the clock spindle 6. The lever 40 is provided with a contact surface 41, which cooperates with a contact 42 carried on a light spring 43. On the other side of the contact 42 is a contact 44, carried by a heavy spring 45. The lever 40 carries a pin 46, which cooperates with the heavy spring 45 to effect disengagement between the contacts 41, 42 and 44 when the lever 40 is rocked by the armature 11, as will appear hereinafter.

The operation of this embodiment of my invention is as follows:

As the clock spring unwinds, lever 40 is rotated clockwise, as viewed in Figure 6. At a predetermined point in the unwinding movement, the contact 41 engages the contact 42 and forces the latter to engage the contact 44, thereby completing a circuit, which extends from one side of the power source through the winding of the magnet coil 13, over heavy spring 45, contact 44, contact 42, lever 40, contact point 39, extension 38, loop 19, armature 11, spindle 35 and returning over the other side of the line. The magnet coil 13 is energized over this circuit and rocks the armature 11 in a counterclockwise direction against the tension of spring 37, applying a force through the loop 19, extension 38 and contact point 39 against the lever 40 and rocking this lever in a counterclockwise direction. This effects a winding of the spring of the clock. At a predetermined point in the counterclockwise movement of the lever 40, the pin 46 thereon engages the heavy spring 45 and rocks this spring in a clockwise direction, disengaging contact 44 from contact 42 and also disengaging contact 42 from contact 41. This disengagement of these contacts interrupts the energizing circuit of the magnet coil 13, whereupon the spring 37 immediately returns the armature to the position shown in Figure 6, in

which it rests against the resilient stop 36. The armature is thus in a position to commence a new winding operation when the lever 40, due to the movement of the clock hands, is brought back to the position indicated in Figure 6.

It is, of course, to be understood that in the embodiment of my invention, shown in Figure 6, the loop 19 performs the same function as in the other embodiments; that is, during the movement of the armature 11, to effect a winding of the clock spring, the loop 19 moves over a pole piece of the yoke 8 to effect a damping of the movement of the armature 11, in the manner hereinbefore described.

My invention, as applied to an ammeter of the moving iron type, is shown in Figure 7, in which a yoke 50, having properly shaped pole pieces 51 and 52, carries a coil 53, which, when energized, operates an armature 54, fixed to a spindle 55. Secured to the spindle 55 is a pointer 56, cooperating with the usual scale (not shown). Movement of the armature is opposed by a coil spring 57 held against a stop 58, serving for adjustment of the zero point. The construction thus far described is characteristic of the well-known moving iron type of ammeter. In accordance with my invention, a short-circuited loop 19 is secured to the armature 54 and so arranged that when the pointer is at its zero position, the loop 19 is spaced from the end of the pole pieces 51, as shown. Upon passage of a current through the coil 53, the armature swings around together with the pointer and in this movement the loop 19 is moved over the pole piece 51, exerting a damping effect on the moving parts, as hereinbefore described.

I have shown in Figure 8 the ordinary type of scale with this type of ammeter, which is usually (particularly with alternating current) crowded at the low end, so that there are difficulties in getting accurate readings.

As explained above, the action of the loop 19, under the influence of the alternating magnetic field, results in a repulsing force between the magnet and short-circuited loop. This action may be explained as follows:

An alternating field induces a voltage in the loop interlinked with it and this voltage sends a circulating current acting thus as a short-circuited secondary of a transformer. Of course, any current of this nature requires a corresponding increase in the current of the primary, which, in the case under consideration, is the exciting coil 53. Since the currents in these coils are flowing in the opposite directions, the resulting force is a repulsion between the two coils and this force is exerted on the loop, thus counteracting directly the attracting force on the armature 54. As a result, for a definite current flowing through the coil 53, an opposite current will flow in the loop 19 and, instead of the full attraction of the armature 54, a repulsive force enters, thus reducing the resulting attraction on the armature and loop combination. With the spring 57 counteracting this attracting force, the resulting movement is evidently less than what it would have been without the short-circuited loop. Therefore, the same current will not attract the armature as far as it did before, or, in other words, a larger current will be required to attract the armature to its final position. If the same full scale reading as before is desired, it would be necessary to reduce the spring tension.

If we assume that the current increases from zero upwards, then not only the attractive force

on the armature increases, but also, as the loop enters the pole piece 51, the repulsive action on this loop increases. Thus, for a definite increase of current the increment of attractive force and corresponding movement is reduced, bringing the points on the scale, corresponding to the higher readings of current, closer to each other. As the weakened spring has already widened the spacing between the low readings of current, this reduction in the high readings of current makes the scale approximately equal throughout the scale. This is illustrated in Figure 9.

If, however, it is desired to widen the range of readings on the instrument, I can merely leave the spring at its former strength and since the higher readings are now brought closer together, the full scale reading will be bigger, as illustrated in Figure 10, while the spacings between consecutive current readings are still approximately even, as compared with Figure 8.

Although I have disclosed the short-circuited loop arrangement as applied to an electric clock and to an ammeter, it will be evident to those skilled in the art that it has utility, not only in such devices, but wherever a damping action is necessary after a certain movement of a rocking armature. Thus, to cite another example, the short-circuited loop arrangement may find useful application in such devices as the electric typewriter, where the movement of the relay controlling the hammer of the typewriter can be conveniently stopped or limited by the reaction of the short-circuited loop, thus avoiding the necessity of stops and the resulting noise.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. A clock winding mechanism, comprising an electromagnet means, including a rocking armature, operable by said electromagnet, to effect winding of said clock and a closed metallic control loop carried by said armature and adapted to encircle a pole piece of said electromagnet retarding the motion of said armature near the end of its spring winding stroke.

2. A clock winding mechanism, comprising an electromagnet, a rocking armature associated with said electromagnet, means operated by said rocking armature for winding the clock mechanism, switching means operated by said armature for controlling the circuit of said electromagnet and a closed metallic loop carried by said armature and adapted to encircle a pole piece of said electromagnet retarding the motion of said armature near the end of its spring winding stroke.

3. A clock winding mechanism, comprising a winding spindle, an armature fixed to said spindle, an electromagnet for operating said armature between predetermined limits, means for preventing undue acceleration of said armature at the beginning of its spring winding stroke and means for retarding the motion of said armature near the end of its spring winding stroke.

4. A clock winding mechanism, comprising a spring winding spindle, an armature fixed to said spindle, an electromagnet for operating said armature between predetermined limits, spring means for preventing undue acceleration of said armature at the beginning of its spring winding stroke, and electro-magnetic means for retarding the motion of said armature near the end of its spring winding stroke.

5. An electrical instrument, comprising an electromagnet, a rocking armature associated with the electromagnet and a closed metallic

control loop carried by said armature, adapted to encircle a pole piece of said electromagnet at a predetermined point in the rocking movement of said armature for retarding said movement by eddy currents produced in said loops.

6. An electrical instrument, comprising an electromagnet having pole pieces, a rocking armature associated with said electromagnet and a closed metallic damping loop carried by said armature, said loop being ineffective when said armature is at rest and adapted to become effective by encircling one of said pole pieces after said armature has traversed a considerable portion of its range of movement.

7. A device of the character described comprising a magnet having pole pieces; a movable armature coacting therewith, and a closed metallic loop associated with said armature, said loop being ineffective when said armature is at rest and adapted to become effective by encircling a

pole piece of said armature after said armature has traversed a predetermined portion of its range of movement.

8. A device of the character described comprising a magnet having pole pieces; a movable armature coacting therewith; and a closed metallic loop carried by said armature adapted to encircle a pole piece of said magnet during the armature movement to act as a damping means for the armature.

9. A device of the character described comprising a magnet having pole pieces; a movable armature coacting therewith; and a closed metallic loop carried by said armature adapted to encircle a pole piece of said magnet after the said armature has traversed a predetermined portion of its range of movement to serve as an eddy current damping means for the armature.

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