July 12, 1932. A. WIRZ 1,867,295

ELECTROMAGNETIC PENDULUM DRIVING DEVICE FOR CLOCKS

Filed May 31, 1930 2 Sheets-Sheet 1

Fig. 1.

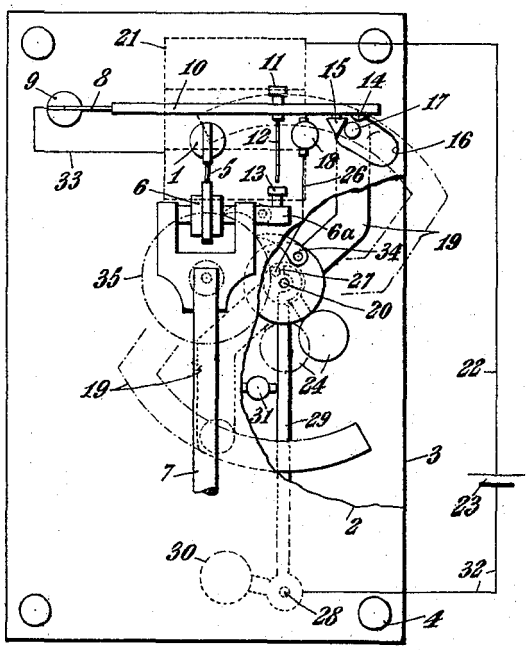

Fig. 2.

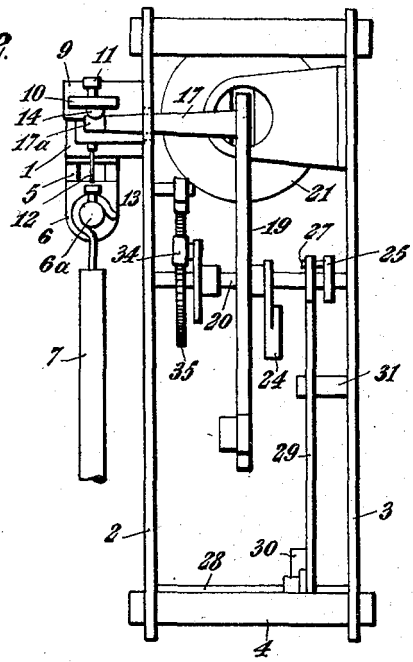

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Fig. 3.

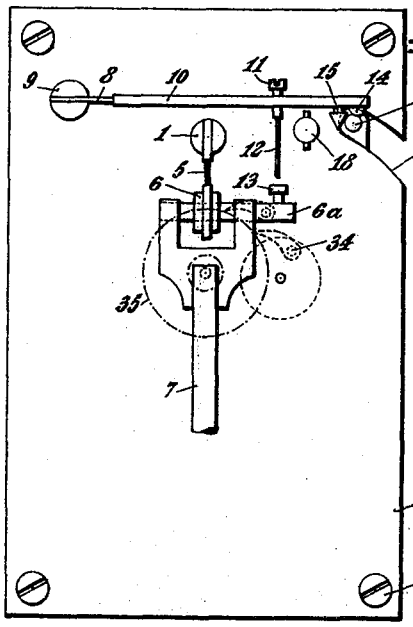

Fig. 5.

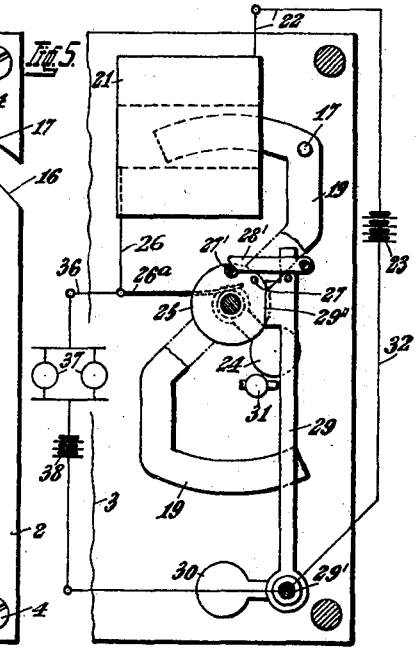

Fig. 4.

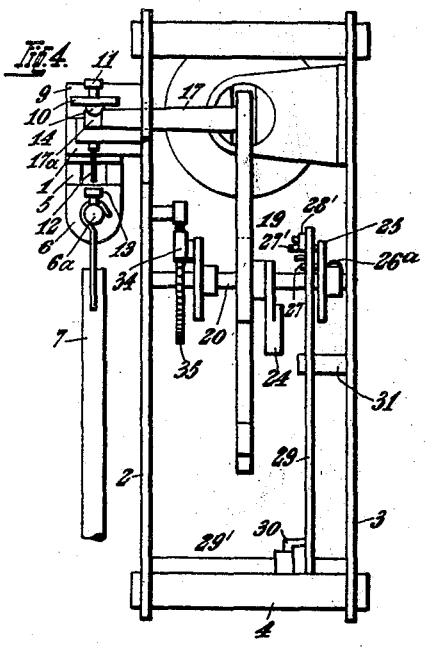

Fig. 6.

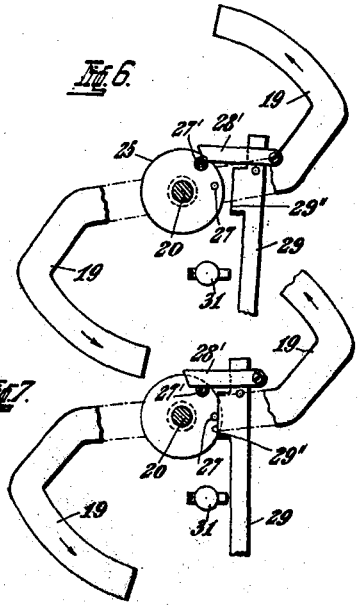

Fig. 7.

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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC PENDULUM DRIVING DEVICE FOR CLOCKS

Application filed May 31, 1930, Serial No. 457,701, and in Switzerland June 16, 1929.

The present invention relates to an electromagnetic pendulum driving device for clocks and the like of the kind wherein the pendulum receives its driving impulse by means of a loading lever which is raised by an electromagnetically operated mechanism. In known driving devices of this kind the electromagnetic mechanism requires too much power to permit sparkless operation, so that in time the contact points of the mechanism oxidize and as a consequence the mechanism either fails to operate or does not operate satisfactorily. Accordingly, the general object of the present invention is to provide a mechanism of the type mentioned which requires only a minor amount of power for its operation and in which practically all sparking of the contact points thereof is eliminated.

Two embodiments of the invention are diagrammatically illustrated by way of example in the accompanying drawings, wherein:—

Figures 1 and 2 are front and side elevation, respectively, showing one form of driving device according to the invention,

Figures 3 and 4 are like views respectively of a second form, and

Figures 5 and 6 show the circuit breaker of the second form in various positions.

Like reference characters designate like parts throughout the several views.

Referring first to Figures 1 and 2, a suspension block 6 of a pendulum 7 is hung from a pin 1 on a front plate 2 of clock-frame 2, 3, 4 by means of a leaf spring 5. A loading lever 10 is mounted above the pin 1 by means of a leaf spring 8 on a pin 9. A small steel rod or needle 12 carried by a screw 11 on the lever 10 extends down from the latter. Below this needle is a flattened head 13 on the extended end 6^a of the pendulum suspension pin. The free end of the loading lever 10 carries a cam 14, formed of a precious stone, and a stop 15 for a loading lever lifting member 17 which extends through a slot 16 in the plate 2. This member 17 is provided with a jewel head 17^a at its free end for cooperating with the cam 14 and stop 15.

Below the loading lever 10 is situated a vertically adjustable contact 18 which limits the downward or driving movement of this lever on the pendulum.

The member 17 is fast on a Z-shaped balanced permanent magnet 19 arranged between the frame plates 2 and 3, which magnet is fast on a shaft 20 journaled in these plates. The upper limb of the magnet 19 extends into a solenoid winding 21 connected by a wire 22 with one pole of a source of current 23. The magnet 19 constitutes the armature of the solenoid and is movable to its withdrawn or normal position relative to the solenoid winding as indicated by dotted lines in Figure 1 by a weighted lever 24 fast on the shaft 20. In this position the armature core 19 is in a condition of equilibrium, as also is the weighted lever 24. As the operative moment of this lever 24 is zero in this position and the work of magnetising the armature, in consequence of employing a permanent magnet, is small, an exceedingly small current suffices to initiate rotation of the armature e. g. a test has shown that 0.005 amp. suffices. It is obvious that practically no spark occurs when such a small current is broken. As the loading lever 10 is a very sensitive part as regards the accurate working of the clock, in the preferred construction shown in Figures 1 and 2 the movement of said lever is utilized to break the solenoid circuit.

Fast on the shaft 20 and electrically insulated therefrom is a disk 25 connected by a wire 26 with the contact piece 18. The disk 25 carries a pin 27 which projects laterally therefrom projecting pin 27 into the path of movement of a lever 29 fast on a shaft 28, which lever 29 is pressed against a stop 31 by a weighted lever 30 on the shaft 28. The lever 29 is connected with the other pole of the source of current 23 by a wire 32, and the loading lever 10 is connected with the solenoid winding 21 by a wire 33.

Pawl-and-ratchet feed mechanism 34, 35 serves in known manner for intermittently transmitting the rotation of the armature shaft 20 to the pointer mechanism of the clock which is not shown in the drawings.

The described pendulum driving device operates as follows: When the pendulum 7

is oscillated and moves to the right as viewed in Figure 1, the head 13 engages the needle 12 and lifts the loading lever 10 with its cam 14 away from the member 17 assumed to be in its operative position shown in full lines in Figure 1. This member 17, released by the cam 14, swings to the right with the upper arm of the armature 19 under the influence of the weighted lever 24 to its normal position indicated by dotted lines in Figure 1. During rotation of the armature the pin 27 strikes against the lever 29 and makes electrical connection therewith. During movement of the pendulum to the left, the leading lever 10 descends and by its weight acting through the needle 12 and the head 13, drives the pendulum until it engages the contact-piece 18. At this moment the electric circuit is closed, the solenoid 21 attracts the core 19 and rotates it from its normal dotted line position to its operative full line position. The pointer mechanism is thereby driven by the feed mechanism 34, 35. At the same time the pin 27 is moved to the left, and the lever 29 under the influence of the weight 30 follows it until the lever engages the stop 31. As the lever 29 is unable to follow the continued movement of the pin 27 to the left, the circuit is broken at this point. This occurs directly before the member 17 strikes against the cam 14 of the loading lever 10. The momentum of the core 19 is, however, sufficient for lifting the lever 10 from the contact-piece 18 by reason of the cam jewel 17^a moving beneath the jewel 14. No flow of current is broken between the parts 10 and 18, however, because the circuit has already been broken between the parts 27 and 29. The member 17 can then move further to the left 14 until it hits the stop 15. The loading beam then descends somewhat, the cam 14 and stop 15 lie on the member 17 and hold the latter and the core 19 in the upper end position until the lever 10 is again lifted by the pendulum swinging to the right, whereupon the cycle of operations is repeated.

Experience has shown that after working for a long period, e. g. many years, the induction currents of the solenoid produce at the contact 18 and at the contacts of the lever 10 a dry electrolysis which causes a crust or rust to be formed that obstructs and finally prevents the flow of current.

The formation of such a crust and the drawbacks connected therewith are avoided in the modified construction shown in Figures 3 to 6 which is described hereinafter only in so far as it differs from the device shown in Figures 1 and 2. The connections 26 and 33 are removed. The disk 25 fast on the shaft 20 is connected with one end of the solenoid winding by a contact spring 26*a* that bears on the hub of the disk. The disk 25 carries a laterally directed pin 27 and an electrically insulated pin 27′ into the path of which extends a locking arm 28′; pivoted to swing upwards on a lever 29 fast on the shaft 29′ for cooperation with the pin 27′. The weighted lever 30 on the shaft 29′ tends to urge the lever 29 against the fixed stop 31. The lever 29 is connected with one pole of the source of current 33 by a wire 32 and carries a lug 29″ in the path of the pin 27. As Figure 5 shows, the circuit-breaker 27, 29 can control the circuit of any desired number of additional or secondary clocks 37 which are connected by a wire 36 with the contact spring 26*a* and preferably by way of one battery 23 with the lever 29 by solenoid winding 21 and the wires 22, 32. The secondary clocks require only a solenoid 21 and an armature 19 for driving their pointer mechanism. The pendulum and loading lever are not necessary. The employment of relays in the secondary clocks is obviated in consequence of the direct control of the circuit by the circuit-breaker 27, 29 of the master clock.

During the rotation of the shaft 20 in the clockwise direction the pin 27′ bears against the arm 28′ and drives the lever 29 away in front of it and brings the latter out of reach of the pin 27, so that the circuit remains broken during the entire rearward or receding movement of the armature 19. As soon as the pin 27′ slides beneath the arm 28′, the lever 29 is rocked back by the weight 30 until its lug 29″ bears against the pin 27. The arm 28′ slides back on to the pin 27′ and at this instant the circuit is closed. The solenoid attracts the armature 19 and rotates it from its receded into its attracted position, and the feed mechanism 34,35 drives the pointer mechanism. At the same time the pin 27 is moved to the left and the lever 29 follows it under the influence of the weight 30 until the lever strikes the stop 31. As the lever 29 cannot follow the continued movement of the pin 27 to the left, the circuit is broken at this point. This occurs immediately, before the member 17 strikes the cam 14 of the loading lever 10 which has descended on to the contact 18 during the reversal of the pendulum movement to the left. The momentum of the armature 19 is, however, sufficient for lifting the lever 10 from the contact 18 by the timing member 17. The latter moves upwards against the loading lever 10 and strikes with its head 17^a against say the lowest part of the cam 14 which yields upwards and raises the lever 10. The member can then move further to the left until it strikes against the stop 15. The lever 10 then descends somewhat, the cam 14 and stop 15 lie on the timing member and hold the latter and the armature 19 in the upper end position. In this position the pin 27′ slides away from under the arm 28′ and lies in front of it. The contacts 27, 29″ can also be used as sliding contacts when the lug 29″ is shortened somewhat

at the top and the pin 27 is arranged to move across its top.

In order that there may be no play between the pin 27′ and the arm 28′ when the armature 19 occupies its outer position, the free end of the arm 28′ is undercut somewhat so that its bevelled face always bears against the pin 17′ in the position shown in Figure 5. The advantage is thereby obtained that the receding movement of the armature is used completely, i. e. without any lost motion, for the return movement of the contact lever 29, and consequently the armature 19 can be placed under the influence of the solenoid 21 until just before the end of its attraction stroke and the timing member 17 is brought with certainty within reach of the loading lever. When the lever 10 is lifted by the pendulum swinging to the right the cycle of operations commences afresh.

As compared with known pendulum driving devices comprising a solenoid that acts on a pendulum the described devices according to the present invention have the advantage that the driving impulse acting on the pendulum is always constant even when the voltage of the source of current falls.

I claim:—

1. An electromagnetic pendulum driving mechanism comprising, in combination, a pendulum, a loading lever to impart movement to the pendulum in one direction, an electromagnet and a cooperating armature having a normal position of equilibrium and movable from such position by the magnet when the latter is energized to lift the loading lever, a magnet circuit means whereby the magnet circuit is interrupted prior to lifting of the loading lever by the armature, whereby the momentum of the armature serves to lift the loading lever, means whereby the loading lever holds the armature against return to its normal position during part of the return movement of the pendulum and whereby the armature holds the loading lever in a raised position, means whereby the last part of the return movement of the pendulum releases the armature and the loading lever to permit the former to return to its normal position and the latter to impart an impulse to the pendulum, and means operable in part by descent of the loading lever and in part by movement of the armature to its normal position to restore the electromagnet circuit.

2. An electromagnetic pendulum driving mechanism comprising, in combination, a pendulum, a loading lever to impart movement to the pendulum in one direction, an electromagnet and a cooperating armature having a normal position of equilibrium and movable from such position by the magnet when the latter is energized to lift the loading lever, a magnet circuit means whereby the magnet circuit is interrupted prior to lifting of the loading lever by the armature, whereby the momentum of the armature serves to lift the loading lever, means whereby the loading lever holds the armature against return to its normal position during part of the return movement of the pendulum and whereby the armature holds the loading lever in a raised position, means whereby the last part of the return movement of the pendulum releases the armature and the loading lever to permit the former to return to its normal position and the latter to impart an impulse to the pendulum, and means to restore the electromagnet circuit following descent of the loading lever and upon return of the armature to its normal position.

3. An electromagnetic pendulum driving mechanism as set forth in claim 2 in which the armature of the electromagnet is of approximately Z-shape and the electromagnet is in the form of a solenoid winding into which one arm of the armature is drawn when the magnet is energized.

4. An electromagnetic pendulum driving mechanism as set forth in claim 2 in which the electromagnet circuit is inclusive of two pairs of contacts connected in series, one pair being controlled by movement of the loading lever and the other pair being controlled by movement of the armature.

In testimony whereof I have affixed my signature.

ALBERT WIRZ.