E. W. VAILL, Jr.

PENDULUM ACTUATED CLOCK.

APPLICATION FILED JUNE 17, 1909.

Patented Nov. 16, 1909.

2 SHEETS—SHEET 1.

940,410.

Fig. 2.

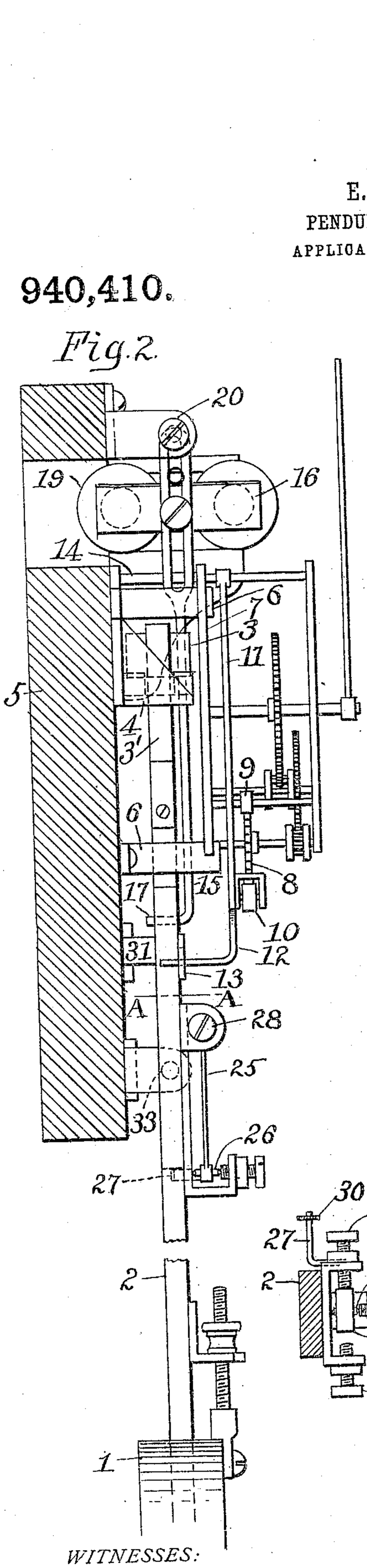

Fig. 1.

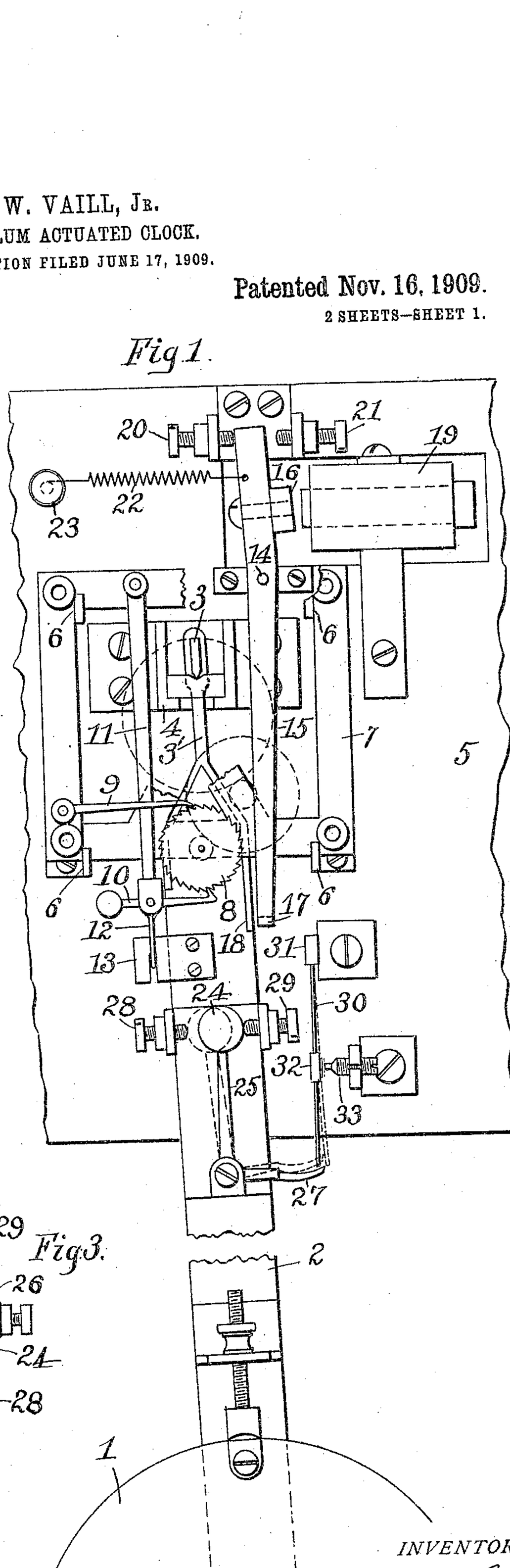

Fig. 3.

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Fig. 5.

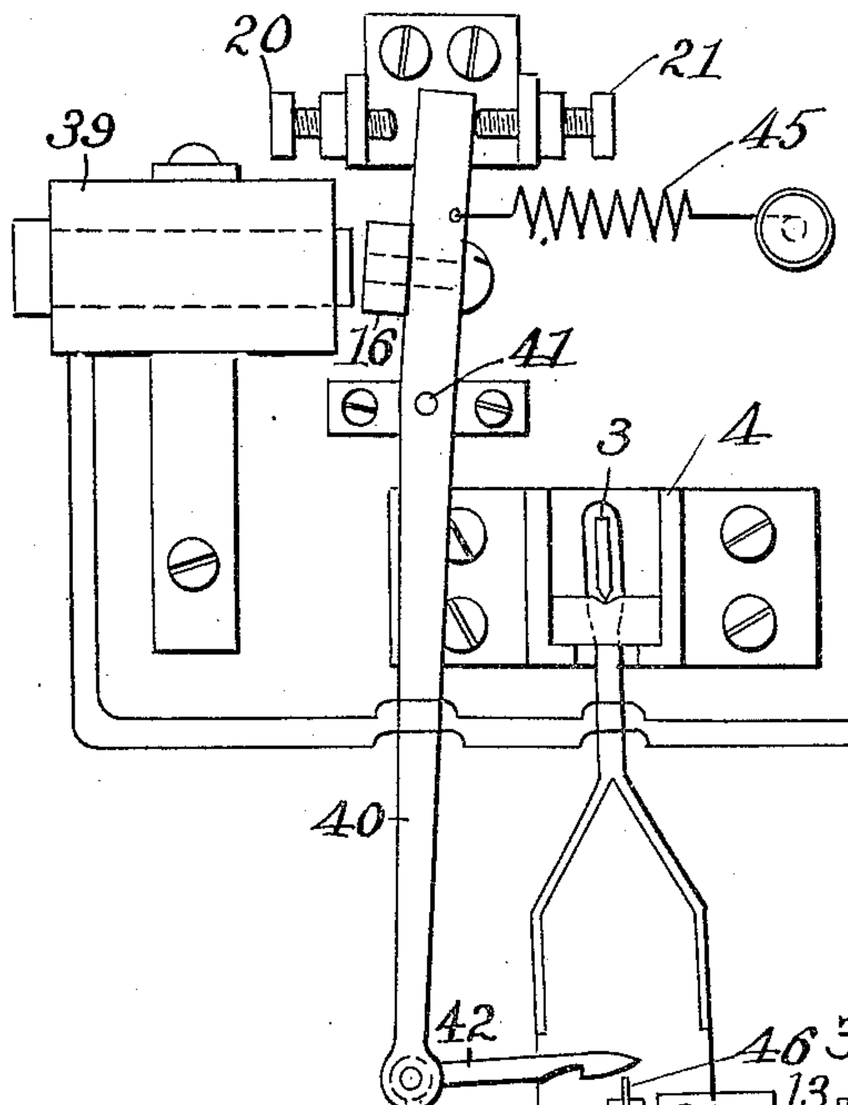
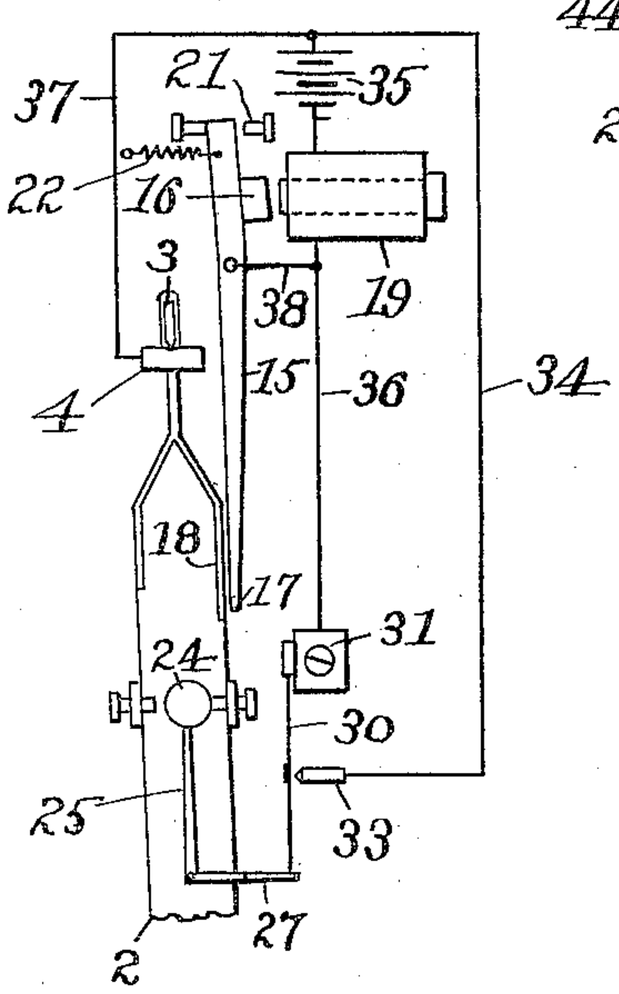


Fig. 4.



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UNITED STATES PATENT OFFICE.

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PENDULUM-ACTUATED CLOCK.

940,410. Specification of Letters Patent. Patented Nov. 16, 1909.

Application filed June 17, 1909. Serial No. 502,667.

To all whom it may concern:

Be it known that I, EDWARD W. VAILL, Jr., a citizen of the United States, residing at Englewood, county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Pendulum-Actuated Clocks, of which the following is a full, clear, and exact disclosure.

My invention relates to primary clocks of the type in which the pendulum is driven directly by an electro-magnet or similar motor mechanism without the intervention of any winding mechanism.

The object of my invention is to produce a driving mechanism of the kind mentioned which shall reduce to a minimum the effect of friction of the moving parts, which shall maintain the amplitude of the vibrations practically constant and one in which the power or driving mechanism is made to act strongly, positively and only at such times as are absolutely required by a very slight loss of momentum or energy in the oscillation of the pendulum weight. This object being accomplished, my invention results in a driving mechanism for clocks which demands no attention except for long periods and requires a minimum amount of electric or other power so that it will run for a year or more on three or four cells of a dry battery and will also permit the clock to keep very accurate time.

For a detailed description of two forms of my invention, reference may be had to the following specification and to the accompanying drawings, forming a part thereof, in which—

Figure 1 is a front elevation of the works of a clock having my improved driving mechanism embodied therein, but showing the front plate of the clock-train frame removed and parts of the rear plate broken away, the gears and pinions being indicated by their pitch lines; Fig. 2 is a side elevation thereof, complete except for the usual hour hand and its gearing which are omitted for simplicity; Fig. 3 is a transverse sectional view of the pendulum taken substantially on the line A—A, Fig. 2; Fig. 4 is a diagram of the electric connections for the driving mechanism of Figs. 1 and 2; and Fig. 5 is a front elevation of a modified form of the means for communicating the power from the magnet to the pendulum rod.

Referring to the drawings the numeral 1 indicates the pendulum weight, 2 the pendulum rod, 3 the knife suspension and 4 a bracket fastened to the back plate 5, which latter supports all of the parts and which is preferably made of electrically non-conductive material. The projecting arms 6 support the frame 7 for the usual clock-train, of which the first wheel is a ratchet wheel 8, having any suitable number of teeth, such as thirty when driven by a standard or seconds pendulum. A fixed pawl 9 prevents the ratchet wheel from turning in a backward direction and the oscillating pawl 10 drives the same. The latter is carried on a pivoted arm 11 which has a downward and rearward extending projection 12 engaging the pendulum by means of a slotted plate 13. By this arrangement the oscillations of the pendulum drive the clock train.

The power mechanism for maintaining the vibrations of the pendulum is arranged as follows: The shaft 14 carries a lever 15, adjacent the upper end of which the armature 16 is attached. The lower end of the lever is bent rearwardly as indicated at 17, or is otherwise so arranged to be in line with the path of movement of the pendulum rod 2 but does not contact with the same, except when the magnet is energized, although the pendulum approaches to within a short distance of it when at the limit of its vibration toward the right as shown in Fig. 1.

The suspension bar 3′ is connected at its lower end with a metallic strap 18 which extends downward on each side of the pendulum rod 2 and is fastened thereto in any suitable way. On the right hand side of the pendulum the strap 18 extends slightly below the adjacent end 17 of the lever 15. 19 indicates the electro-magnet acting upon the armature 16.

20 and 21 are set screws for limiting the motion of the lever 15. A spring 22 and tension screw 23 maintain the lever in its inoperative position when not acted upon by the magnet. It will be seen that when the magnet is energized the pull on the armature 16 will be transmitted to the lower end of the lever 15, forcing its end 17 against the strap 18, at the same time giving an impulse to the pendulum toward the left.

The contact making device is arranged as follows: The numeral 24 indicates a small weight carried upon an arm 25 pivoted at its lower end as at 26. A laterally extending arm 27 projects from the pivot 26 for a

short distance beyond the side of the pendulum rod 2. Set screws 28 and 29 form adjustable limiting stops for the weight 25 as it oscillates above the pivot 26. The end of the screw 29 is very slightly nearer the central line of the pendulum rod than that of the screw 28. Both of the screws are so adjusted that when the vibrations of the pendulum are greater than a certain predetermined minimum amplitude the pivot 26 will pass below the center of gravity of the weight 24 which will fall against the opposite or lower stop at the end of each vibration. In Fig. 1 the full lines indicate the position of the weight at the end of a vibration toward the right just before it falls against the lower stop 28. When the vibrations of the pendulum have been reduced to the above mentioned minimum amplitude the pivot 26 will not pass far enough toward the left beyond the vertical line through the center of gravity of the weight 24 when it rests against the stop 28 and the weight will therefore not fall against the opposite stop 29 but will remain against the stop 28 during a complete oscillation, since the latter stop is slightly farther from the axial line of the pendulum than the stop 29. Thus, when the said predetermined minimum amplitude has been reached the weight will always remain against the stop 28 during at least one complete oscillation. Such being the case, the next vibration of the pendulum toward the right after the weight fails to leave the stop 28 will cause the end of the arm 27 to move in a higher arc.

The set screws or stops 28 and 29 and their above described adjustment in relation to the pivot 26 therefor constitute means for preventing the oscillation of the weight 24 when the vibrations of the pendulum are less than a pre-determined amplitude, or in other words, the stops allow the weight to oscillate only when the vibrations of the pendulum are above a pre-determined amplitude.

A leaf spring 30 having its upper end attached to a standard 31 is so situated that its lower end is just in line with the path or arc of movement of the end of the arm 27 when it is in its higher position as shown in dotted lines in Fig. 1, but will be just cleared by said arm when in its lower position, as shown in full lines. The spring 30 carries a contact piece 32 which is located opposite the end of an adjustable contact screw 33. When the weight 24 remains in contact with the stop 28 during one oscillation of the pendulum toward the right, the spring will be deflected by the arm 27, as shown in dotted lines, closing the operating circuit between the contacts 32 and 33 thereby energizing the magnet and giving an impulse to the pendulum through the lever 15. To cause the magnet to act during the entire vibration toward the left, the electric circuit is maintained closed during such time. This is accomplished by the arrangement of electric circuits shown in Fig. 4. When the magnet acts owing to a closing of the circuit at the contact screw 33, the current passes through the wire 34, battery 35, magnet 19, wire 36, standard 31 and spring 30. When the magnet acts upon the armature 16, the lower end of the lever 15 contacts with the strap 18 on the pendulum 2. This closes a shunt circuit around the contact screw 33 as follows: From the strap 18 through the suspension 3, bracket 4, wire 37, battery 35, magnet 19, wire 36, wire 38 and lever 15. The first circuit having been broken, the latter circuit is maintained until the lever 15 contacts with the set screw 21, or the armature 16 with the end of the core of the magnet 19, which it should slightly before the pendulum reaches the end of the vibration toward the left. The contact between the lever 15 and the strap 18 is then broken, the magnet deënergized, and the spring 22 retracts the lever to its original position where it remains until the circuit is again closed at the contact screw 33. An impulse having thus been given to the pendulum, the weight 24 will thereafter vibrate between the stops 28 and 29 until the minimum amplitude has again been reached.

I have found that in a clock constructed substantially as above described, a contact is made about once a minute with a magnet having 50 ohms resistance and with a dry battery of four cells connected in series and after several months use of the battery. The change in the amplitude of the pendulum just before and just after an impulse is scarcely discernible with the unaided eye although the oscillating weight very easily and positively detects it.

The modification of the driving mechanism shown in Fig. 4 is described as follows: The lever 40 is pivoted at 41 and has the armature 16 attached thereto adjacent its upper end. The lower end of said arm carries a hooked pawl 42 extending from the pivot of which is an arm 43. An adjustable stop 44 contacts with said arm 43 and maintains said pawl in an elevated position when the lever 40 is retracted by the spring 45 so that its upper end rests against the stop 21. The pendulum rod carries a small vertical plate or knife edge 46 over which the pawl 42 is adapted to hook. The contact-making device and the pivoted weight for controlling the same is the same as that shown in Fig. 1. The contact device, magnet and battery are simply connected in series. When the magnet 39 is energized by the momentary closing of the circuit at the end of a vibration, the armature 16 is attracted thereby moving the pawl 42 toward the right so that it hooks

over the knife edge 46. The spring 45 then acts to pull the pawl toward the left thereby giving an impulse to the pendulum. Just before the pendulum has reached the end of its movement toward the left, the stop 44 raises the pawl 42 so that it remains free from the knife edge 46 until the magnet is again energized. In this form of the device less electric current is used at each impulse of the pendulum as the contact is made practically instantaneously at the end of the stroke, but as the spring does not act as powerfully as the direct pull of the magnet a larger number of contacts is necessary.

A clock constructed as shown in Figs. 1–3 inclusive and having a wooden pendulum rod has been found to vary less than ten seconds per month.

It is obvious that my improved motor controlling device may be utilized for operating a driving mechanism energized by the use of compressed air or other fluid under pressure.

Having thus described these forms of my invention, I do not wish to be understood as being limited to the details of form and arrangements of parts set forth, for various changes may be made without departing from the spirit and scope of my invention.

What I claim and desire to protect by Letters Patent is:

1. A controlling device for pendulum actuated clocks, comprising, an oscillatory weight connected with the pendulum, means for preventing the oscillation of said weight when the vibrations of the pendulum are less than a predetermined amplitude, power mechanism for driving the pendulum, and means for making said power mechanism active when said weight ceases to oscillate.

2. A controlling device for pendulum actuated clocks, comprising a weight connected with the pendulum and adapted to oscillate when the vibrations of the pendulum are more than a predetermined amplitude, means for preventing the oscillation of the weight during vibrations of the pendulum less than said amplitude, a power mechanism, and means connected with said weight for making said power mechanism active when said weight ceases to oscillate.

3. A controlling device for pendulum actuated clocks, comprising an oscillatory weight, means connected with the pendulum for causing the center of oscillation of said weight to vibrate in accordance with the vibrations of said pendulum, means for preventing the oscillation of the weight during vibrations of the pendulum less than a predetermined amplitude, a pendulum driving device, and means connected with said weight for making said driving device operative when said weight ceases to oscillate.

4. A controlling device for pendulum actuated clocks, comprising an oscillatory weight connected with the pendulum, stops for limiting the movement thereof to a less extent in one direction than the other past the center line of oscillation, and a motor device made operative by the movement of the pendulum when said weight rests against the stop farther removed from the center line of oscillation during a complete oscillation of the pendulum.

5. A circuit controlling device for pendulum actuated clocks, comprising an oscillatory weight having its center of oscillation carried by the pendulum, stops for limiting the movement of said weight to a less extent in one direction than in the other past its center line of oscillation, a motor device, and means connected with said weight for making said motor device operative when said weight rests against the stop farther removed from its center line of oscillation, during a complete oscillation of the pendulum.

6. A circuit controlling device for electric clocks, comprising an oscillatory weight connected with the pendulum, means for preventing the oscillation of said weight when the vibrations of the pendulum are less than a predetermined amplitude, an electromagnet for driving the pendulum, a contact in circuit with said magnet, and means connected with said weight for closing said contact when said weight ceases to oscillate.

7. A circuit controlling device for electric clocks, comprising an oscillatory weight connected with the pendulum, means for preventing the oscillation of said weight when the vibrations of the pendulum are less than a predetermined amplitude, an electromagnet for driving the pendulum, a spring, a contact operated thereby, and means connected with said weight for deflecting said spring to close the circuit through said contact when said weight ceases to operate.

8. A controlling device for pendulum actuated clocks, comprising an oscillatory weight, a pivot carried by the pendulum and by which said weight is supported, stops for limiting the oscillations of said weight unequally in relation to said pivot, an arm extending from said pivot, power mechanism for driving the pendulum, and means located in the path of the end of said arm when said weight ceases to oscillate, for making said power mechanism active.

9. A controlling device for pendulum actuated clocks, comprising an upright arm having a weight at its upper end and pivoted at its lower end to the pendulum, stops for limiting the oscillations of said weight unequally in relation to the center line of said pendulum, an arm extending laterally from said pivot, power mechanism for driving the pendulum, and means located in the path of the end of said lateral arm when said weight ceases to oscillate for making said power mechanism operative.

10. A power device for pendulum actuated clocks, comprising an electromagnet, a contact in circuit therewith, means carried by the pendulum for closing said contact when the vibrations of the pendulum are less than a predetermined amplitude, a second contact in shunt with the first and closed by the action of the magnet, and means for breaking said second contact at the end of a vibration.

11. A power device for pendulum actuated clocks, comprising an electromagnet, a contact in circuit therewith, means carried by the pendulum for closing said contact when the vibrations of the pendulum are less than a predetermined amplitude, a lever actuated by said magnet and adapted to bear at one end against said pendulum, which is conductive from its point of suspension to the bearing point of said lever, said lever and the conductive part of said pendulum being in shunt with said contact, and means for separating said lever and pendulum at the end of a vibration.

12. A power device for pendulum actuated clocks, comprising an electromagnet, an armature therefor, a lever to which said armature is attached and adapted to bear at one end against said pendulum which is conductive from its point of suspension to the bearing point of said lever, an electric circuit including said magnet, pendulum and lever, means for separating said pendulum and lever at the end of a vibration, a contact in shunt with said pendulum and lever, and means carried by the pendulum for closing said contact when the vibrations of the pendulum are less than a predetermined amplitude.

13. The combination with a pendulum or similar oscillating device, of electrical means to give it added impulse when oscillating, an electrical circuit including such impulse means, and also make-and-break devices, one of which devices is adapted to be moved in relation to the other by the movement of the oscillating device to momentarily close the electric circuit at the end of a vibration, and auxiliary means operated by said electrical means for causing the power of said electrical means to act during a complete vibration of the oscillating device.

14. The combination with a pendulum or similar oscillating device, of an electric circuit, electric means in said circuit to impart energy to the oscillating device, primary electric contacts which are closed by the oscillating device but which normally open the circuit, and secondary contacts normally open but which are closed by the electrical means during a vibration of the oscillating device in one direction.

Signed, this 16th day of June, 1909.

EDWARD W. VAILL, Jr.

Witnesses:

John D. Carberry,

H. Richard Worse.