Student Handout 1-Magnetic Clock Patent

Courtesy of the United States Patent and Trademark Office

3 Sheets—Sheet 1.

D. DRAWBAUGH.

MAGNETIC CLOCK.

No. 367,898. Patented Aug. 9, 1887.

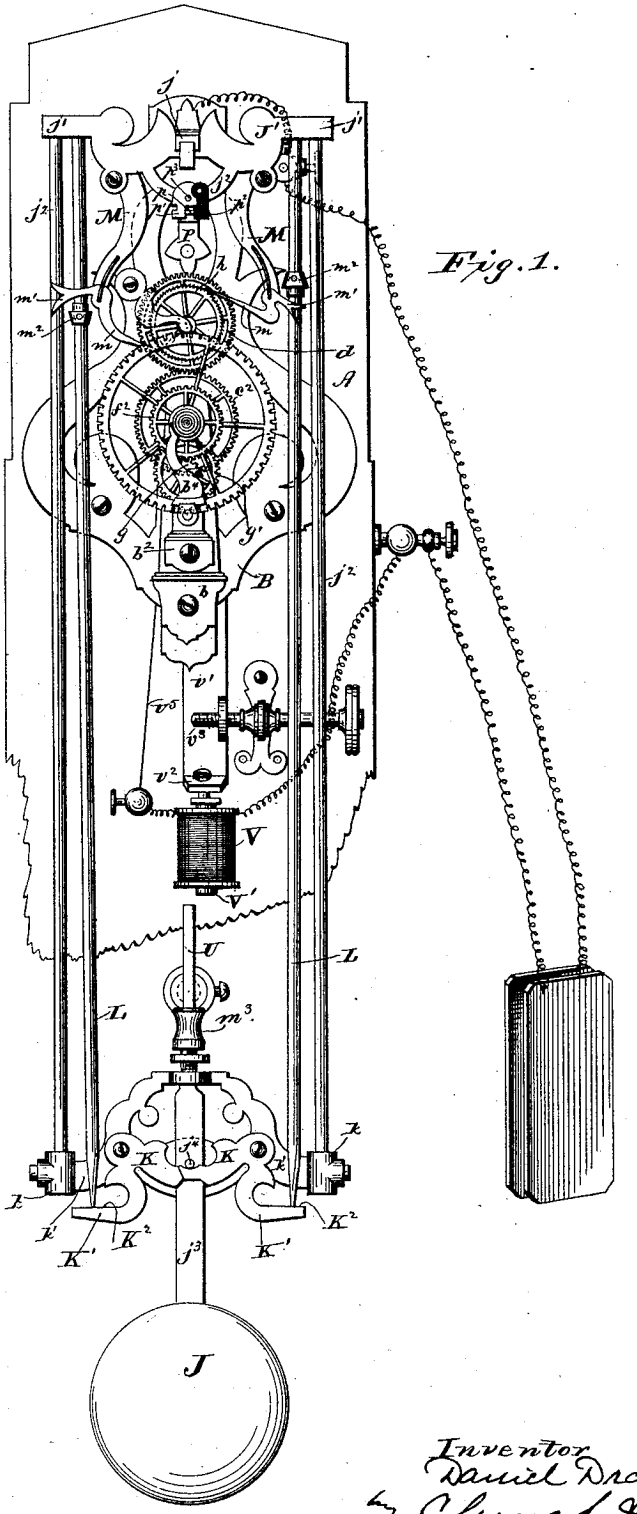

Fig. 1.

Witnesses.
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Fred'k. Church.

Inventor
Daniel Drawbaugh,
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Fig. 2.

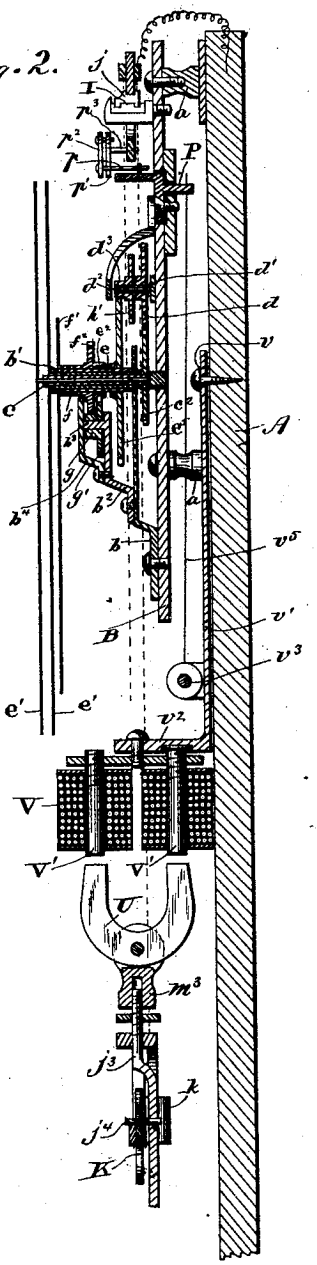

Fig. 5.

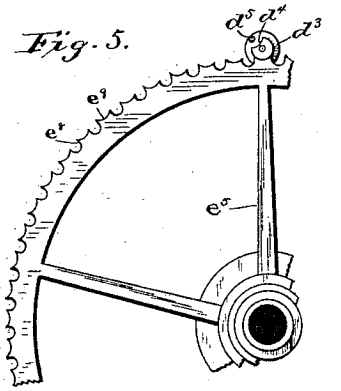

Fig. 6.

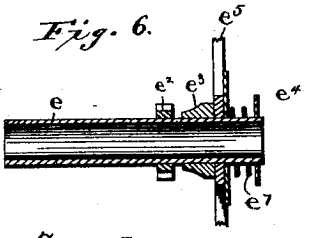

Fig. 7.

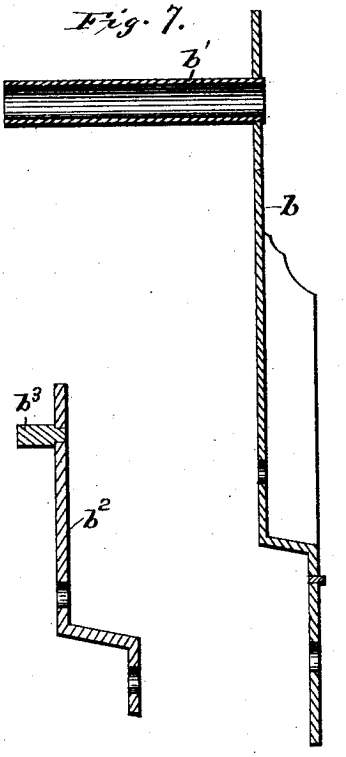

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Fig. 3.

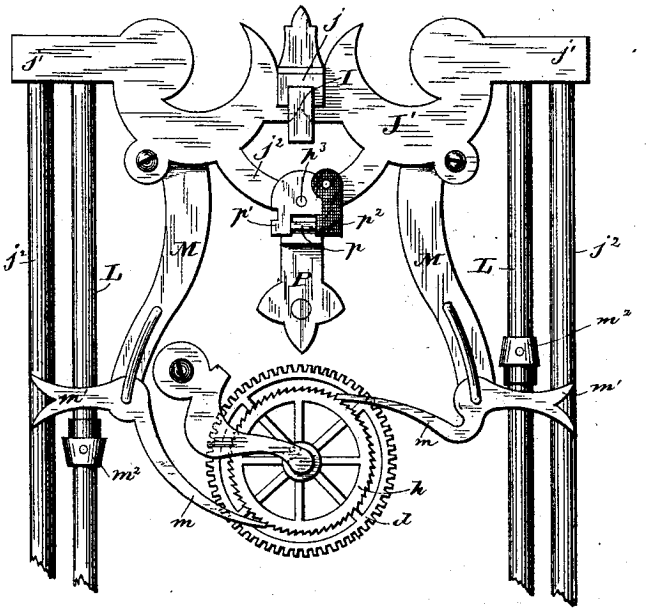
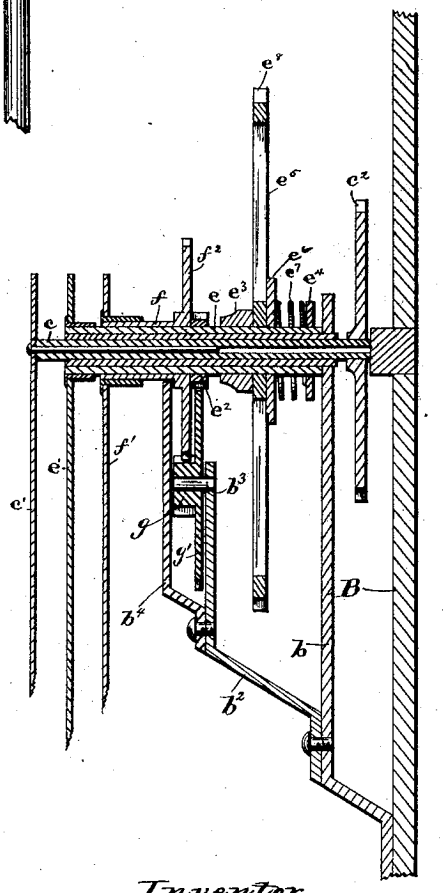


Fig. 4.



Witnesses.
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UNITED STATES PATENT OFFICE.

DANIEL DRAWBAUGH, OF EBERLY'S MILL, ASSIGNOR TO EDGAR W. CHELLIS, OF HARRISBURG, PENNSYLVANIA.

MAGNETIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 367,898, dated August 9, 1887.

Application filed May 29, 1878.

To all whom it may concern:

Be it known that I, DANIEL DRAWBAUGH, of Eberly's Mill, in the county of Cumberland and State of Pennsylvania, have invented certain new and useful Improvements in Magnetic Clocks; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to that class of mechanism designed more especially for measuring and registering divisions of time, wherein the motive power employed is electricity and the governor a pendulum; and it consists in the several novel and improved constructions and arrangements of parts, as hereinafter more fully described, and pointed out in the claims, whereby the structure of such a device is simplified and accuracy of movement secured with the expenditure of but little power.

In the accompanying drawings, Figure 1 is a front plan view, and Fig. 2 a central vertical section, of the operating parts of a clock mechanism, exhibiting the application of my improvements. Fig. 3 is a front elevation of a portion of the pendulum and the driving mechanism. Fig. 4 is a longitudinal vertical section of the mechanism controlling the movement of the hands. Fig. 5 is a detail showing the manner of connecting the driving mechanism and the mechanism controlling the hands. Fig. 6 is a detail showing the manner of connecting the arbor of the minute-hand and the master-wheel. Fig. 7 illustrates a portion of the supporting-plate or main frame.

Similar letters of reference in the several figures indicate the same parts.

The mechanism controlling the movements of the hands is all mounted upon a metallic plate or frame, B, supported upon posts *a*, rising from the base-plate A.

The clock mechanism proper, or that for effecting the regular and proportional movements of the hands, is constructed and applied as follows: To the plate B is detachably secured a bracket, *b*, whose upper or free portion stands a short distance from the plate B, and is provided with a sleeve or tubular post, b', and to the bracket *b* is in like manner secured a second bracket, b^2, carrying a post, b^3, and keeper b^4. Mounted to turn freely within the sleeve b' is a spindle, *c*, carrying the seconds-hand c', and provided at its rear end with a pinion, c^2, in gear with a pinion, *d*, supported upon a spindle, d'. Upon the exterior of the sleeve b' is fitted a sleeve, *e*, carrying the minute-hand e', and upon the last-named sleeve is mounted a sleeve, *f*, to which the hour-hand f' is attached. The sleeve *f* carries a wheel, f^2, in gear with a pinion, *g*, supported upon the post b^3, and attached to a wheel, g', in gear with a pinion, e^2, secured to the sleeve *e* of the minute-hand, the several wheels and pinions f^2, *g*, g', and e^2 being so proportioned relative to each other that twelve revolutions of the sleeve *e* will effect one revolution of the sleeve *f*.

The keeper b^4 stands across the end of the post b^3, with its end in front of the wheel f^2 on the sleeve *f*, serving not only to retain the pinion *g* and wheel g' in position upon said post, but also to hold the sleeve *f* in operative position upon the sleeve *e*. Loosely mounted upon the sleeve *e*, between a hub, e^3, secured to the said sleeve and a removable collar, e^4, is the large wheel e^5, through which the necessary movements are transmitted to the minute and hour hands.

Surrounding the sleeve *e* and interposed between the collar e^4 and a washer, e^6, in contact with wheel e^5, is a spring, e^7, which serves to maintain a sufficient frictional connection or contact between the said wheel and its sleeve to drive the latter, at the same time permitting the sleeve to be turned within the wheel for the purpose of setting the minute-hand, when necessary.

On the periphery of the wheel e^5 are formed a series of relatively-wide teeth, e^8, with concave ends or surfaces e^9, and upon the arbor d^2, to which the pinion *d* for driving the seconds-hand is mounted, is secured a hub, d^3, fitting within the concave ends of the teeth e^8 and provided with a cut away portion, d^4, and a pin, d^5, for entering the spaces between the teeth e^8. By means of the hub d^3, entering the concave ends of the teeth e^8, the wheel e^5 is

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prevented from moving until the pin d^5 enters the space between contiguous teeth, when said wheel will be moved through a distance equal to the width of one tooth, and again held until, during the revolution of the arbor d^2, the pin shall engage the next tooth.

In the example given the parts are so proportioned that one complete revolution of the arbor d^2, representing sixty seconds, as indicated by the movement of the hand c', shall advance the wheel c^5, and with it the hand c', one-sixtieth of a revolution, representing one minute, at the same time advancing the hour-hand proportionally, as will readily be understood.

To the arbor supporting the pinions for actuating the hands, as described, is attached the driving or escapement wheel h.

At or near the upper end of the plate B is secured a knife-edge, I, or other suitable support for the pendulum J, which is constructed and arranged as follows: To a plate or cross-head, J', is secured a hardened bearing, j, resting upon the knife-edge I, constituting the suspension-point or center of vibration of the pendulum. To each end j' of this cross-head J', and on opposite sides of the pivot, is secured a rod, j^2, whose lower end passes into or through a socket, k, in a cross-piece, k', said rods being adjustably fastened in the sockets and serving as suspension-rods for sustaining the pendulum J. The stem j^3 of the pendulum is provided with a pin, j^4, which is secured, and the weight sustained upon the inner curved ends of the two levers, K K, pivoted upon the cross-piece k'. The outer ends or arms, K^2, of the levers K are formed in arcs of circles, of which the rods L constitute the radii. The upper extremity of each rod L rests in contact with one of the ends j' of the cross-head J', and the lower end bears upon the curved surface of the arms K^2, in which latter are formed a series of bearings to receive the rounded ends of the said rods L. The rods j^2 and L are made of metals having different rates of expansion—as, for example, the rods j^2 may be of steel and the rods L of brass—and they are so proportioned and placed with respect to each other and the points of bearing upon the levers K as that any elongation or shortening of the rods j^2 from the effects of heat or cold shall be compensated for by the raising or lowering the pendulum with respect to the cross-piece k', upon which it is sustained, this effect being produced by the superior rate of expansion or contraction of the rods L acting upon the lever K, thereby raising the pendulum in proportion as the fulcrums of the levers K are lowered, and vice versa.

The cross-head J' carries two arms, M, adjustable about their points of attachment and provided with pawls m, whose inner ends or points make contact with the teeth of the ratchet-wheel h, and are held in engagement therewith by gravity. Both of said pawls extend outward beyond the pivot, their outer ends, m', projecting the one above and the other beneath an adjustable collar or stop, m^2, secured to the rods L. These stops m^2 operate to sustain the pawls when the points of the latter are retracted or swung back upon the ratchet-wheel, serving as a means for regulating the motion to be communicated to the gears at each oscillation of the pendulum by limiting the stroke of the points upon the teeth of the ratchet-wheel.

As will be readily understood, at each movement of the pendulum from one extreme to the other one of the pawls will operate upon the ratchet-wheel and advance the mechanism connected thereto a distance proportional to the stroke of the pawl and the point of engagement with the ratchet-wheel, and the same motions occur upon the return of the pendulum, the opposite pawl being then brought to bear upon the ratchet-wheel and the other retracted. The amount of movement thus produced at each oscillation of the pendulum can be regulated at this point by the adjustment of the collars for sustaining the pawls and of the arms bearing the pawls with respect to the cross-head. Upon the upper end of the stem of the pendulum is screwed or otherwise adjustably secured a block, m^3, carrying a permanent magnet, U.

To the base A is pivotally attached, as at v, a plate or hanger, v', provided with a lateral extension or foot, v^2, to which latter is secured an electro-magnet, V. The pole-pieces V' of this electro-magnet V are arranged above and facing the extremities of the horseshoe-magnet carried upon the pendulum, and the point at which the cores of the electro-magnet and extremities of the permanent magnet coincide, as the latter are carried to and fro by the pendulum, is regulated by an adjusting-screw, v^3, or equivalent device, operating upon the support for the electro-magnet. It will thus be seen that the magnet is adapted to operate as an adjustable polarized armature for the electro-magnet.

One terminal of the electro-magnet V is connected to one plate or pole of a source of electricity, and the opposite terminal is connected by a wire, v^5, with a bracket, P, insulated from but supported upon the plate B. This bracket has pivoted upon it a rod or strip, p, of conducting material. The outer end of this conductor p projects between two plates, p' p^2, the former, of conducting material, fastened by a pin, p^3, to the cross-head j^2, and the latter, p^2, of non-conducting material, pivotally supported upon and adjustable with respect to the plate p'. The opposite terminal of the battery or other source of electricity is connected to the cross-head j^2, as shown, so that the circuit through the electro-magnet will be closed so long as the plate p' maintains contact with the strip p. The two plates p' p^2, which serve to close and open the circuit, are adjusted and held apart so as to leave a space between their free ends somewhat greater that the width of the conducting-strip p. As

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the pendulum oscillates from one extreme to the other, the plate p' is held against and carries the strip p with it to the opposite extreme; but as soon as the pendulum reaches its highest point and commences to move in the opposite direction the plate p' is drawn out of contact with strip p and the circuit is broken, the plate p^2 during the return movement operating merely to carry the strip p back to the starting-point and leave it in position to be again engaged by the plate p'.

The electromotor described is applied and caused to operate upon the pendulum to actuate the latter at regular intervals, and thus keep it oscillating in the following manner: By means of the adjusting devices applied to the support for the electro-magnet the latter is fixed to one side of the center of oscillation of the pendulum, with its cores facing a point at or near the extreme end of the arc through which the permanent magnet on the pendulum swings, so that at each alternate excursion the poles of the permanent magnet will be caused to approach and face those of the electro-magnet. The circuit through the coils and the connections with the battery or other source of electricity are so arranged that when the circuit is closed and the cores temporarily magnetized the poles of the permanent magnet will face the opposite poles of the electro-magnet, so that they will be mutually attracted. The connection being made and the various parts adjusted, as described, the pendulum is set in motion. As it swings toward the electro-magnet the plate p' bears against the conducting-strip p, thereby closing the circuit through the electro-magnet and energizing its cores, and causing the latter to attract the permanent magnet. As the pendulum, being propelled by gravity, passes the center its power diminishes; but the attractive power of its magnets for each other increases, so that the loss is compensated or more than compensated for, and the pendulum is raised to or above the elevation from whence it started. During this excursion of the pendulum the plate p' remains in contact with the strip p, carrying it over to one side; but as soon as the extreme of movement is reached and the pendulum starts in the opposite direction, or toward the side from whence it started, the plate p' is moved away from the strip p, thereby breaking the circuit through the electro-magnet and holding it open during the return movement, the insulating-plate p^2 serving merely to carry the conducting-strip p back to the starting-point, to be again acted upon by the plate p' upon the next forward movement of the pendulum.

The advantage secured by the employment of a permanent magnet with poles opposed to those of the electro-magnet and located to one side of the center, and in arranging the mechanism so as to break the circuit as the poles pass, is two-fold: first, to enable the clock to be driven with a relatively weak current, such as may be supplied by what is known as an "earth battery," and, secondly, to secure a practically-continuous action and regular movement of the pendulum. This last-named result is due in a large measure to the manner of applying and operating the electro-magnet relatively to the permanent magnet, whereby the strength of the latter is maintained, instead of being reduced, at each successive beat of the pendulum, as the charging-circuit is broken the instant the pendulum begins to move away from the electro-magnet, thereby producing in the coils a secondary or induced current in the opposite direction, which not only deprives the cores of their attractive force, but by momentarily reversing their polarity accelerates the departure of the permanent magnet.

Experience has demonstrated that with a mechanism such as described, when a permanent magnet is affixed to the pendulum of insufficient strength or power to run the clock mechanism, if the pendulum is oscillated by hand or otherwise, the permanent magnet will gradually gain strength until sufficient power is developed to actuate the clock without other assistance.

It will be observed that the compensating devices on the pendulum, while serving to preserve the length of the latter, also operate to maintain the poles of the permanent magnet at the same distance from the cores of the electro-magnet, and thus prevent variations, which would otherwise occur in the propelling power.

Having thus described my invention, I claim as new—

1. In a clock such as described, and as a means for actuating the devices controlling the movements of the hands or pointers, the pivotally-supported cross-head to which the pendulum is attached, the gravitating pawls, and the ratchet-wheel, in combination with the stops engaging said pawls to limit their movement relative to the ratchet teeth, substantially as described.

2. In combination with the driving-spindle of the clock mechanism, and the ratchet-wheel mounted thereon, a pivoted cross-head provided with adjustable arms carrying pawls, compensating suspension-rods attached to the cross-head and bearing the pendulum, and stops such as described, applied to the suspension-rods and engaging the pawls, as and for the purpose set forth.

3. The combination, with the main frame or plate B, provided with the bracket b, carrying sleeve b', and the bracket b^2, of the spindle c, sleeves e and f, and gears for driving spindle c and sleeve e from the main driving-shaft, and the gear mounted on the bracket b^2, for transmitting motion from sleeve e to sleeve f, substantially as described.

4. In a clock mechanism such as described, the combination, with the driving-shaft and its gear, of the spindle carrying the second-hand, supported within a tubular bearing or sleeve, and the sleeve carrying the minute-

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hand, supported upon the exterior of said tubular bearing, the driving-wheel for the minute-hand sleeve, the washer or collar upon the sleeve, and the spiral spring operating to move the wheel longitudinally on its support to form an elastic frictional connection between the wheel and sleeve, substantially as described.

5. In a clock mechanism such as decribed, and in combination with the devices for controlling the movements of the hands, the ratchet-wheel, the pawls supported upon the cross-head for alternately engaging the teeth of the ratchet, the suspension-rods secured at their upper ends to the cross-head and at their lower ends to a cross-piece, the levers mounted upon the said cross-piece and engaging the stem of the pendulum, and the rods bearing upon the cross-head and levers, substantially as and for the purpose set forth.

6. In a clock such as described, and in combination with the pendulum for actuating the mechanism thereof, the permanent magnet secured to the pendulum, the stationary electro-magnet with cores of opposite polarity facing the poles of the permanent magnet and located to one side of the center of oscillation of the pendulum, an electric circuit, including the electro-magnet and a source of electricity, and a circuit-breaker connected to the pendulum and included in the electric circuit, operating to interrupt the current as the poles of the electro and permanent magnets are brought in line and the pendulum begins its reverse movement, substantially as described.

7. In a clock such as described, the combination, with the compensating rods supporting the pendulum, and the magnet connected to the stem of the pendulum, of the stationary electro-magnet located within the arc traversed by the pendulum and co-operating with the magnet borne by the latter to drive the pendulum, substantially as described.

8. In a clock such as described, and in combination with the pivoted cross-head, the suspension-rods, the cross-piece, the levers supporting the stem of the pendulum, and the expansion-rods interposed between said levers and cross-head, the magnet secured to the stem of the pendulum, the electro-magnet co-operating with said first-named magnet, and a circuit-breaking device for interrupting the flow of current through said electro-magnet, substantially as described.

9. The combination, in a clock such as described, of a pendulum operating upon the clock mechanism to drive the latter, a fixed electro-magnet, a polarized armature attached to the pendulum, and a circuit-breaker for closing the circuit during the oscillation of the pendulum toward the electro-magnet and opening it when the pendulum is moving in the opposite direction, substantially as described.

10. The combination, in a clock such as described, and with devices for actuating the hands driven from the pendulum, of a permanent magnet attached to the pendulum and standing radially of its center of oscillation, and an electro-magnet located at a point within the arc traversed by the pendulum, but to one side of the center thereof, and with its cores facing the said permanent magnet, substantially as described.

11. In a clock such as described, the combination, with the actuating devices and the pendulum of the opposing magnets, the conducting and non-conducting plates borne by the cross-head, of the pendulum, the movable conducting-strip mounted upon the frame and having its free end projecting between the said plates, and the electric generator and circuit-connection, such as described.

12. In a clock such as described, the combination, with the pendulum and its attached magnet, of the electro-magnet mounted upon a pivoted support, and the adjusting devices for changing the position of the electro-magnet relatively to the arc traversed by the pendulum, substantially as described.

13. In a clock such as described, the combination, with the movable stem of the pendulum and compensating devices therefor, of an armature attached to said movable stem, and an electro-magnet located at or near the end of the arc traversed by the pendulum, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have hereunto set my hand and seal this 23d day of May, 1878.

DANIEL DRAWBAUGH. [L. S.]

Witnesses:

WASHINGTON J. HINES,

PETER STUCKER.