Aug. 28, 1956 I. REINER 2,760,331

ELECTROSTATIC PENDULUM CLOCK

Filed July 9, 1953 4 Sheets-Sheet 1

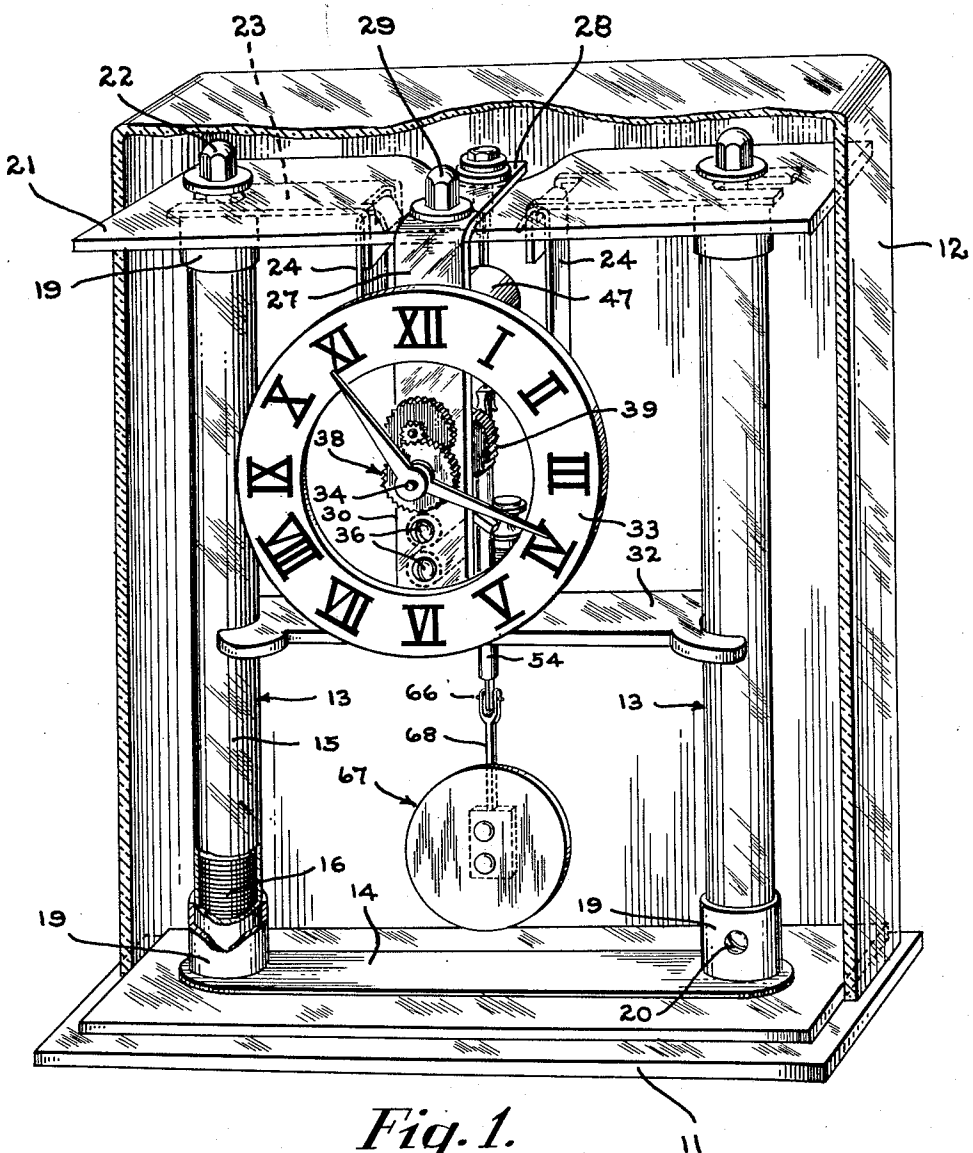

Fig. 1.

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Filed July 9, 1953 4 Sheets-Sheet 2

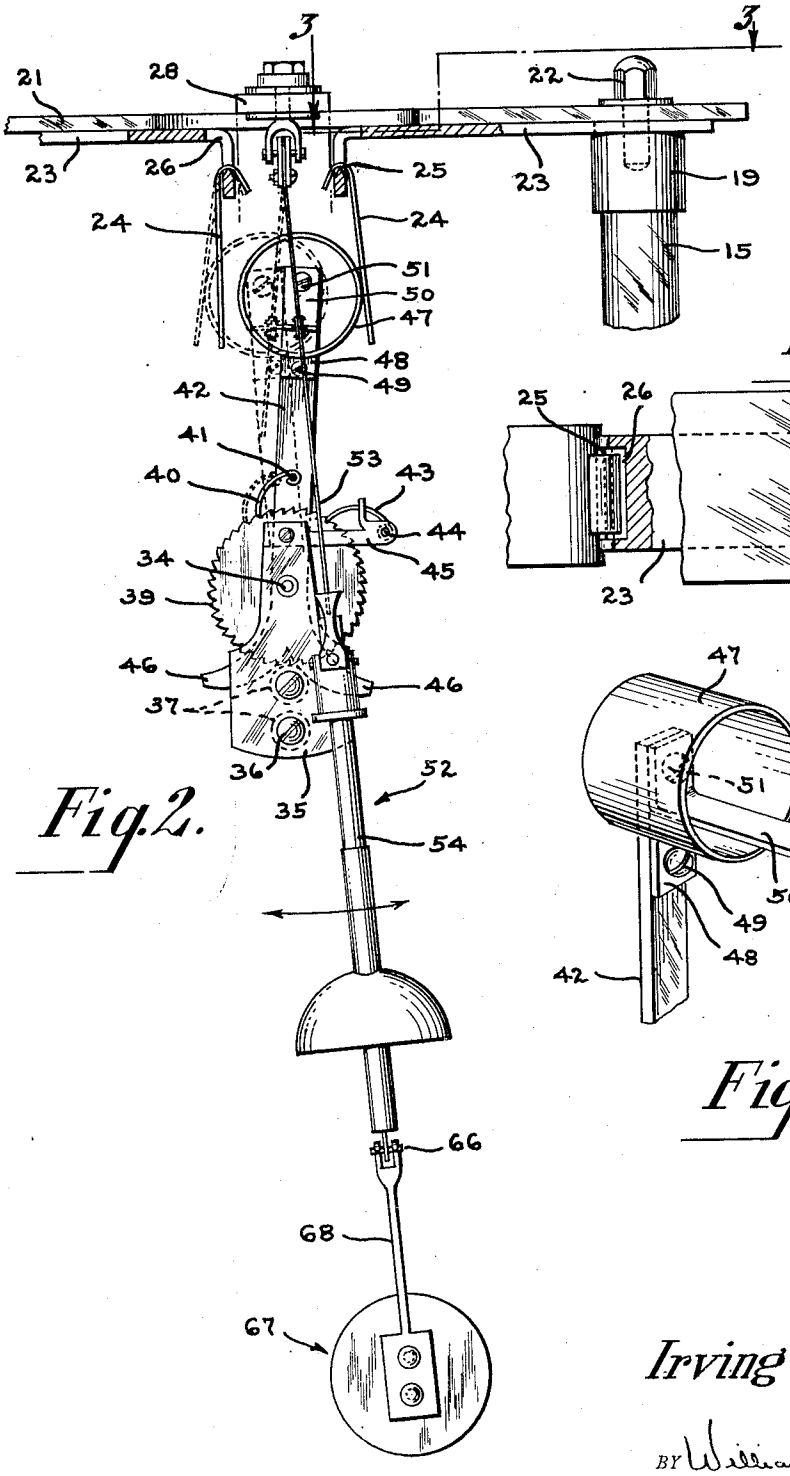

Fig. 2.

Fig. 3.

Fig. 4.

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Aug. 28, 1956 2,760,331

ELECTROSTATIC PENDULUM CLOCK

Filed July 9, 1953 4 Sheets-Sheet 3

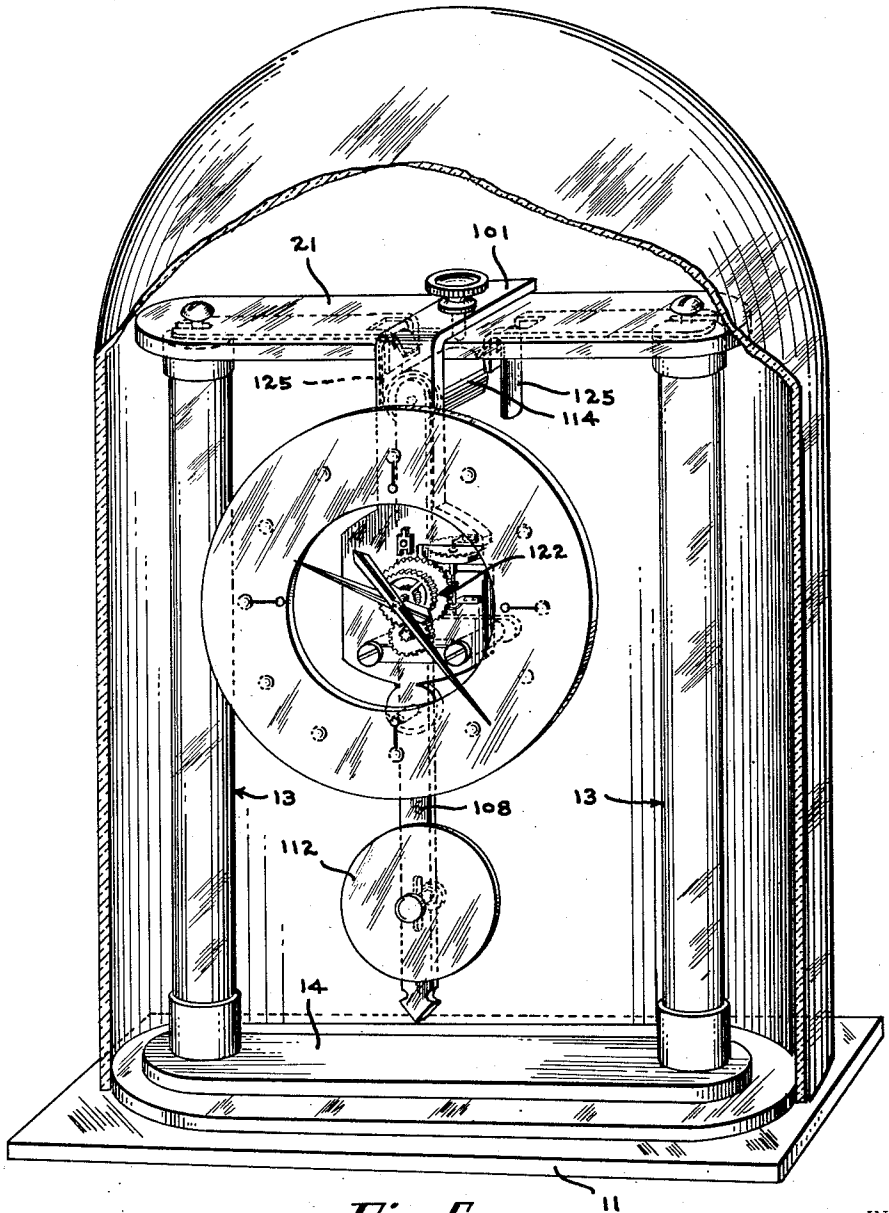

Fig. 5.

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Aug. 28, 1956 I. REINER 2,760,331

ELECTROSTATIC PENDULUM CLOCK

Filed July 9, 1953 4 Sheets-Sheet 4

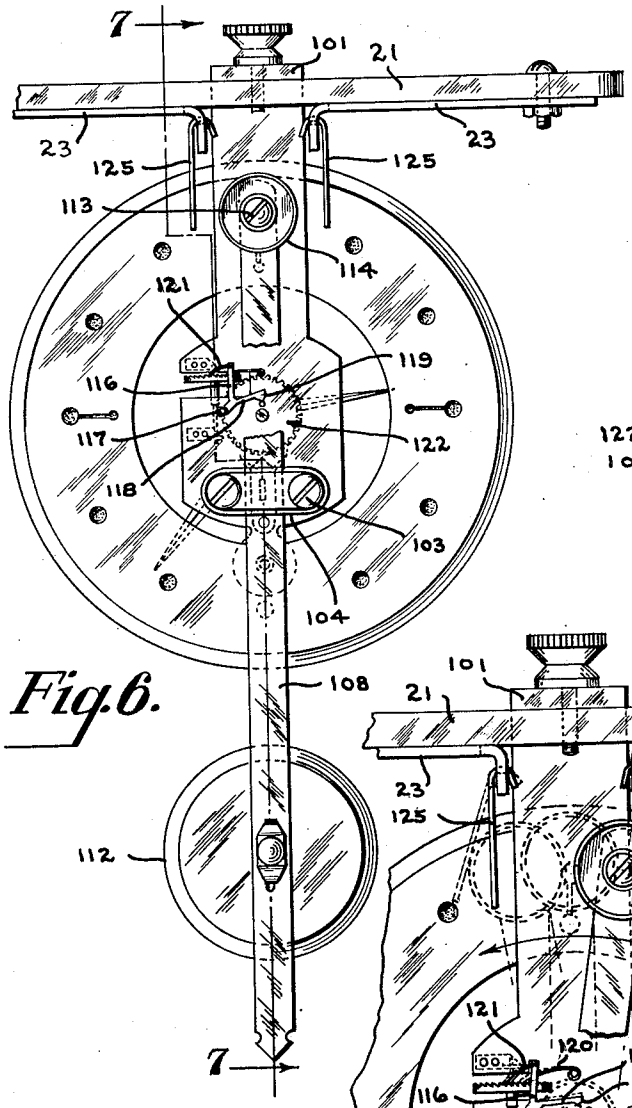

Fig. 6.

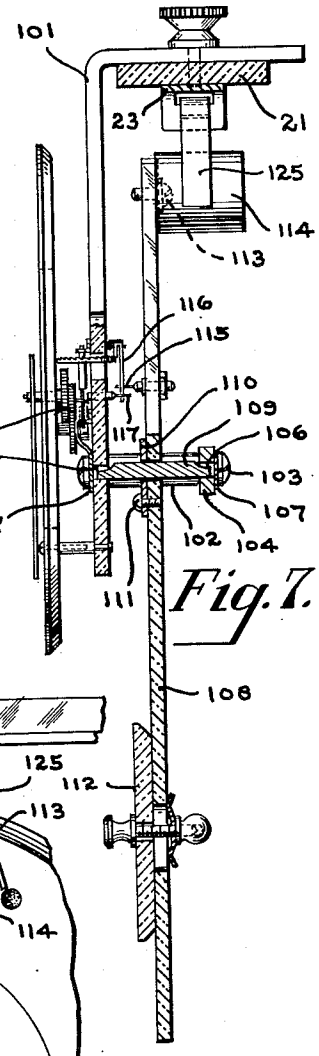

Fig. 7.

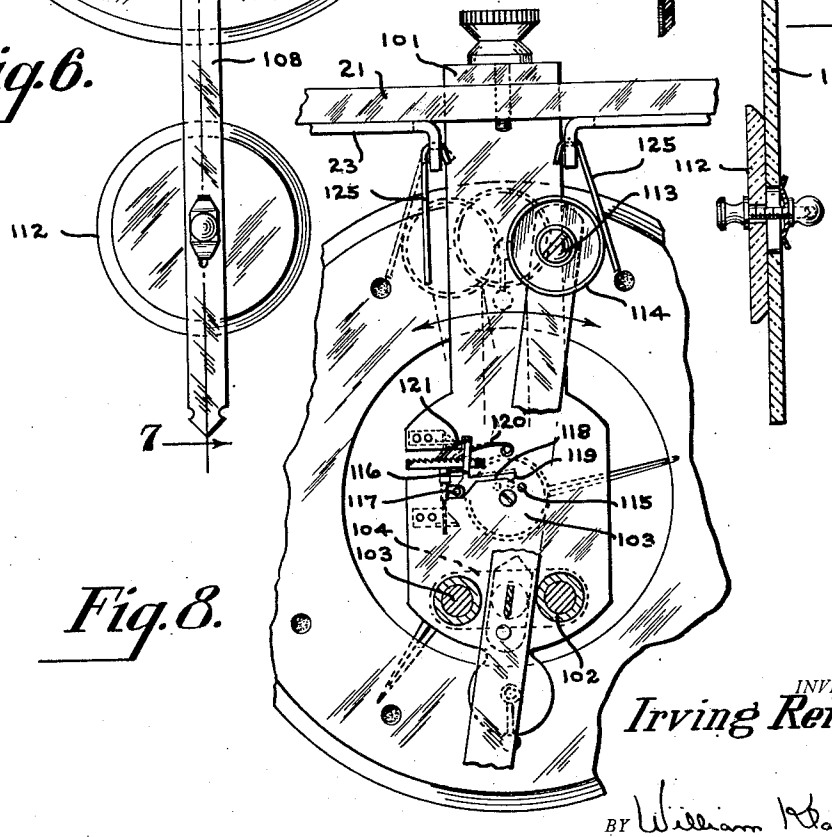

Fig. 8.

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United States Patent Office 2,760,331 Patented Aug. 28, 1956

2,760,331

ELECTROSTATIC PENDULUM CLOCK

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Application July 9, 1953, Serial No. 367,015

4 Claims. (Cl. 58—30)

This invention relates to an electric clock, and particularly to a battery-operated pendulum type clock. The invention constitutes an improvement in the type of clock disclosed in my Patent No. 2,625,787 for an Electric Clock, issued January 20, 1953, on application Serial No. 248,762, filed September 28, 1951.

The above-mentioned patent discloses a dry-cell battery constructed to provide extreme long life and to be capable of delivering electrostatic charges of relatively high potential to an oscillating conductor, the impulses delivered to the conductor being mechanically transmitted to the pendulum of the clock and being of such force as to overcome the forces of deceleration acting upon the pendulum. The patent discloses the application of the battery to clocks employing either a simple pendulum or a torsion pendulum.

The present invention has particular application to clocks of the simple pendulum type, although it is not necessarily limited thereto. It has been found that when the impulse receiving member of the aforementioned patent, that is, the insulated conductor which oscillates back and forth between the battery electrode contacts, is halted abruptly at each end of its path of oscillation by reason of the contact members being rigidly fixed to the supporting framework of the clock, there is a tendency for the shock of the sudden stop to be transmitted through the associated mechanical linkage to the pendulum wire at the intermediate point along its length where the forces tending to compensate for the forces of deceleration are externally applied. When the pendulum wire is contacted by the force-delivering member before the full momentum of the pendulum has been spent there is a tendency for the pendulum wire to bend at such intermediate point, thus in effect creating a secondary pendulum with a shorter pendulum arm extending from the point of bending to the center of mass of the pendulum weight. This effect is undesirable, and in order to avoid it the electrode contacts of the battery element must be critically adjusted.

It is a primary object of the present invention to provide movable electrode contact members which, when engaged by the oscillating conductor member before the pendulum has reached its maximum distance of swing, may readily be deflected from their normal position of rest and which will return to their normal position when the oscillating member reverses its direction of movement.

A further object of the invention is to provide a rigid pendulum arm to which the conductor member is rigidly affixed and which is rotatable in an oscillatory manner about a substantially frictionless bearing member and is maintained in a slight condition of unbalance, such that balance may be partially restored by the application to the oscillating member of the forces resulting from the impulses delivered by the battery electrodes to the conductor. The electrode contact members are deflectable by the pendulum, and when released from contact therewith return by force of gravity to their normal position.

In accordance with the invention, I provide movable contact members at the end of the adjustable electrodes, which contact members are elongated and are pivotally suspended from the electrodes so as to hang in a vertical position. When engaged by the oscillating conductor, the movable contacts are readily deflected against the force of gravity by the slight remaining energy of the swinging or rotating pendulum.

In further accordance with the invention there is provided a rigid pendulum bar pivotally resting at an intermediate point along its length on a horizontal knife-edge, so that the pendulum bar may rock freely on the knife-edge with a minimum of friction. The lower end of the pendulum bar is slightly weighted so that the center of its mass will be below the knife-edge, and the upper end of the pendulum bar carries a rigidly mounted conductor insulated from the pendulum and adapted to oscillate between the movable contacts picking up and delivering electrostatic impulses of sufficient magnitude to overcome the forces tending to bring the pendulum arm to a state of rest.

For a fuller understanding of the invention, reference may be had to the following description and claims taken in connection with the accompanying drawings forming a part of this invention, in which:

Fig. 1 is a perspective view of a simple pendulum clock, such as that disclosed in my Patent No. 2,625,787, to which the movable contact members of the present invention have been applied;

Fig. 2 is a rear fragmentary elevational view showing the clock mechanism as adapted for operation by a simple swinging pendulum;

Fig. 3 is a fragmentary plan view of the portion of the mechanism of Fig. 2 indicated by the line 3—3.

Fig. 4 is an enlarged fragmentary perspective view of the cylindrical conductor and the forked mechanism which transmits the movement of the pendulum of Fig. 2 to the pivoted bar which supports the cylinder from the clock framework;

Fig. 5 is a perspective elevational view of a clock embodying the rigid rotating pendulum of the present invention;

Fig. 6 is a rear elevational view of the clock mechanism of Fig. 5, omitting the housing and battery elements;

Fig. 7 is a side sectional view taken along the line 7—7 of Fig. 6; and

Fig. 8 is an enlarged view of the upper portion of Fig. 6, with portions cut away to more clearly reveal the structural details.

Referring now to the drawings, the clock mechanism is shown supported on a base 11 of non-conductive material and enclosed within a casing 12 which, for decorative purposes, may be of transparent material.

Two horizontally-spaced upright electric storage batteries 13 of the dry cell type are secured at their lower ends to base 11. The batteries are elongated and extend vertically upward a distance sufficient to provide support for the clock mechanism. The lower ends of batteries 13 are connected by a flat conductor strip 14 which may be positioned either on top of or underneath the base 11, the latter arrangement being shown in the particular embodiment illustrated. Each battery 13 comprises a non-conductive cylindrical tube 15 filled with flat thin circular discs 16 of hygroscopic material, such as paper, each coated on one side with a layer of manganese peroxide and on the other side with a layer of zinc, both of which materials are applied in the form of finely-divided powder to the surfaces of the paper discs and are made to adhere thereto by a suitable bonding material, such as dextrin, glue, starch, etc. The discs are placed in face-to-face contact to form a galvanic pile filling the

tube 15, enough pressure being applied to the ends of the pile to maintain good electrical contact between adjacent discs. Each disc 16 is an individual primary cell, the electrolyte of which is provided principally by moisture hygroscopically contained within the paper disc, such moisture being sufficient in amount to provide the necessary chemical action, but not so great as to cause too rapid deterioration of the cell.

The ends of the tubes 15 are covered and sealed against the admission of moisture, as by caps 19 of conductive material removably secured to the tubes, as by screws 20.

A cross-bar 21 of non-conductive material extends horizontally across the upper ends of battery posts 13 so as to rigidly connect the same and to form a sturdy horizontal supporting beam from which the clock mechanism may be suspended. The cross-bar 21 is removably attached to the upper caps 19 by threaded members 22.

Flat bar members 23 of conductive material are interposed between upper closure caps 19 and cross-bar 21 and extend inwardly and are turned down at their inner ends to provide supports for the movable electrode contact members 24. Contact members 24 are elongated flat strap members of conductive material hooked at their upper ends. The hooked ends rest on knife-edges 25 formed on the lower edges of openings 26 provided in the turned-down ends of the bar members 23, as shown in Figs. 2 and 3.

In the embodiment of the invention illustrated in Figs. 1 to 4, employing a simple swinging pendulum comprising a pendulum weight supported by a wire, an irregular U-shaped support member 27, turned sidewise, has its upper horizontal portion 28 secured to the center of cross-bar 21 by a threaded member 29, and its vertical base portion 30 positioned forward of the plane containing batteries 13. The support member 27 supports the entire clock mechanism, and is braced at its lower end by lateral members 32 which extend horizontally from each side of the lower horizontal portion (not shown) of U-shaped member 27 to the sides of batteries 13. The ends of members 32 curve partially around the cylindrical battery housings, thus providing sturdy lateral support.

The face of the clock comprises a flat ring 33, which is secured in any suitable manner to the vertical base portion 30 of U-shaped member 27, and carries the numerals on its forward face.

The main shaft 34 projects through the central opening in the annular face of the clock and has a minute hand attached in conventional manner to its outer end. The forward part of main shaft 34 is journaled in the vertical portion 30 of U-shaped member 27, and the rear part is journaled in an elongated vertical support member 35 which is attached at its lower end to the rear face of vertical portion 30 by means of screws 36 and spacers 37, shown in Fig. 2.

A conventional gear train located just forward of the front face of portion 30, and generally indicated at 38, is connected to both shaft 34 and the hour hand rotatably mounted thereon.

A ratchet-wheel 39 is rigidly secured to shaft 34 near its back end, and just forward of the vertical support member 35. The ratchet-pawl 40 of the ratchet-wheel is pivotally connected at 41 to an upwardly extending elongated bar 42 of non-conductive material. Bar 42 is rotatably mounted on the shaft 34 just forward of the ratchet-wheel 39. A ratchet-dog 43, which serves to prevent reverse rotary motion of the ratchet-wheel when the ratchet-pawl is dragged over the toothed surface to engage a new tooth, is pivotally connected at 44 to the free outer end of a bracket 45 which is attached at its inner end to the support member 35.

The lower end of elongated bar 42 is bifurcated, the branches 46 of the bifurcated portion extending downwardly on either side of the uppermost of spacers 37, and serving both to limit rotation of bar 42 to a relatively small arc on either side of the vertical, and to substantially counter-balance the upper elongated portion. The bar 42 is just slightly top-heavy, so that it may exert a slight force against the electrodes 25 when it reaches each end of its arcuate path.

A hollow conductive cylinder 47 having its axis horizontal is attached to the upper end of bar 42, a tab portion 48 being turned downward from the bottom side of the cylinder and secured to the bar 42 by a screw 49. A flat elongated member 50 has an upturned end attached, as by screw 51, to the upper end of bar 42. Member 50 projects horizontally through the cylinder 47 to a point a substantial distance rearward of the cylinder. The free end of member 50 is forked so as to receive a pendulum wire.

A simple pendulum, generally indicated by the numeral 52, is suspended at the rear end of upper horizontal portion 28 of U-shaped member 27. The upper portion of the pendulum 52 comprises a wire 53, and the lower portion comprises an elongated rigid tubular member 54.

The upper end of wire 53 is held in a clamping device removably attached to member 28. The lower end of wire 53 is adjustably held in a second clamping device attached to the upper end of tubular member 54. The pendulum wire has attached thereto at an intermediate position along its length a clamp member 82, forming a wear block adapted to be positioned between the tines of forked member 50 and engageable therewith to carry the forked member and its associated cylinder 47 back and forth with the oscillation of the pendulum.

The lower end of tubular portion 54 of the pendulum 52 is provided with a diametrical pin 66, from which the pendulum weight, generally indicated by the numeral 67, is suspended by means of hook member 68 attached to the weight. The weight 67 may be of any convenient shape.

The operation of the clock is as follows: The electrode bar members 23, which are made adjustable by being slotted at their outer ends where they are clamped to the battery posts 13, are initially set so that the hanging contact members 24 are engaged by the oscillating cylinder 47 just before it reaches the end of its path of movement. The momentum of the pendulum 52 transmitted through the forked member 50 and the cylinder 47 is sufficient to deflect the contact member 24, causing it to rotate slightly on the knife-edge 25. The resistance of the contact member to such rotation is insufficient to cause any appreciable bending of the pendulum wire 53. The deflection of the contact member serves a two-fold useful purpose. First, it provides a good electrical contact because the contact member rests by force of gravity against the surface of the cylinder while the latter completes the final portion of its movement; and, second, the weight of the contact member leaning against the cylinder, even though slight, causes a portion of the initial acceleration of the pendulum to be supplied by the weight of the contact member. This accelerating force is in addition to the force of repulsion created between cylinder and contact member as soon as the former gives up its charge to the latter and they both acquire the same polarity.

Since the battery terminals or contacts 24 are always oppositely charged, the insulated conductive cylinder 47 picks up the charge of one and carries it to the other. As soon as the cylinder picks up a charge from one of the contacts 24 it is repelled by it, because of the similarity of charges. As it nears the opposite contact 24 with this acquired charge it is attracted strongly toward it by the dissimilarity of charges. Their engagement is accelerated by such attraction, but as soon as physical contact is effected the cylinder loses its charge to the contact member and receives from it a charge of opposite polarity, whereupon it is again repelled. The repeated impulses given to the pendulum through the linkage con-

necting the cylinder and the pendulum wire serves to compensate for or overcome the forces tending to prevent the pendulum from swinging indefinitely.

Referring now to the embodiment of the invention illustrated in Figs. 5 to 9, I have shown a modified form of simple pendulum. Instead of the U-shaped support member **27** I attach to the cross-bar **21** at its center an inverted L-shaped member **101** having its short branch resting horizontally on the cross-bar **21** and its long branch extending downwardly in front of the cross-bar. The longer branch is broadened at its lower end so as to provide a supporting structure for the clock mechanism and for the pendulum.

Extending rearwardly from the lower end of the vertical branch of L-shaped member **101** are a horizontally spaced pair of parallel spacer sleeves **102**. Screws **103** passing through member **101** and sleeves **102** support a rear bearing block **104**. Member **101** and member **104** are provided with alined bearing openings **105** and **106**, respectively, closed at their outer ends by cover plates **107** held against the members **101** and **104** by the screws **103**.

An elongated pendulum bar **108** of non-conductive material passes vertically between the spaced sleeves **102** and has affixed thereto at an intermediate point a knife-edged pivot bar **109**. Pivot bar **109** passes laterally through pendulum bar **108** from front to back and has its ends resting within the bearing openings **105** and **106**. If the pendulum bar is fabricated from relatively-soft plastic or other material, the pivot bar may be set in a plate of harder material, such as plate **110** secured to the pendulum by a screw **111**.

The lower end of pendulum bar **108** carries a longitudinally adjustable pendulum weight **112**, and the upper end of the pendulum has attached thereto, as by screw **113**, a hollow conductive cylinder **114**. The pendulum bar also carries, at a point intermediate the cylinder **114** and the pivot bar **109**, a pin member **115** projecting forwardly from the front face of the pendulum. The pin **115** is oscillated along an arcuate path by movement of the pendulum and engages intermittently at the middle of its path of movement a bell-crank member **116** pivotally supported by pivot pin **117** mounted at one end in the member **101** and extending rearwardly therefrom.

Bell-crank **116** has a generally horizontal arm **118** having a downwardly-extending V-shaped projection **119** at its outer end, and a vertical arm **120** carrying a pivotally mounted feeding-pawl **121** at its upper end. As the pin **115** moves back and forth it engages the projection **119** and momentarily raises the bell-crank arm **118**. In known manner, and by conventional means, generally indicated by the gear train **122**, the movement of the crank arm is transmitted to the hands **123** of the clock, the face of which is indicated by the numeral **124**.

The pendulum is so balanced that the slightly major portion of its weight is below the knife-edge pivot **109**. As the pendulum rocks back and forth, the hollow cylinder **114** engages the movable contact members **125** similar in function if not identical in design to the contact members of Figs. 1 to 4.

Since the pendulum of Figs. 5 to 9 has a shorter radius than that illustrated in Figs. 1 to 4 it will oscillate more rapidly than the simple wire pendulum of Figs. 1 to 4, having its pivot point at the top of the clock. The solid bar pendulum has a decided advantage over the spring wire type of pendulum in one respect, however. It is not as seriously affected by atmospheric conditions, such as changes in temperature. The solid bar pendulum will have a shorter period of oscillation than the pendulum type shown in Fig. 1, but this is not considered a disadvantage.

What is claimed is:

1. In a clock having a ratchet and pawl for actuating same, a pendulum bar provided with means whereby it is vertically suspended and adapted to oscillate about a fixed horizontal axis at a point spaced along said bar a short distance above its center of gravity, means for effecting intermittent driving engagement between the ratchet and pawl in response to the oscillations of said pendulum, an electrically conductive member carried by said pendulum bar and insulated therefrom, said member being arranged to oscillate with the pendulum along an arcuate path, battery means for delivering electrostatic charges of opposite polarity, rigid conductors extending from the terminals of the battery means to locations spaced above the ends of said arcuate path, rigid contact members pivotally suspended by their upper ends from the ends of said conductors and having their lower ends in such position as to be engaged and slightly displaced by said electrically conductive member as it nears the ends of said arcuate path.

2. Apparatus as defined in claim 1 including a horizontal pin projecting from said pendulum, and a bell-crank pivotally supported on the framework of said clock, one end of said bell-crank being engageable by said pin each time said pendulum passes the midpoint of its path, thereby effecting a slight angular displacement of said bell-crank, and the other end pivotally supporting said pawl.

3. Apparatus as in claim 2 in which said bell-crank is arranged to return by force of gravity to its initial position after each angular displacement by said pin.

4. Apparatus as in claim 1 in which said conductors are strap members turned downwardly at their free ends and provided with horizontal slots in the turned-down portions, said contact members being hooked at their upper ends through said slots.

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