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Marble

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[54] **SIMULATED PENDULUM CLOCK**

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[73] Assignee: **General Electric Company,** Bridgeport, Conn.

[22] Filed: **Dec. 23, 1971**

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[52] **U.S. Cl.** **58/29,** 58/33, 58/129

[51] **Int. Cl.** **G04b 47/04**

[58] **Field of Search** ..... 58/23 V, 23 D, 29, 58/26, 30, 31, 32, 132, 133; 310/15, 36; 318/123, 130

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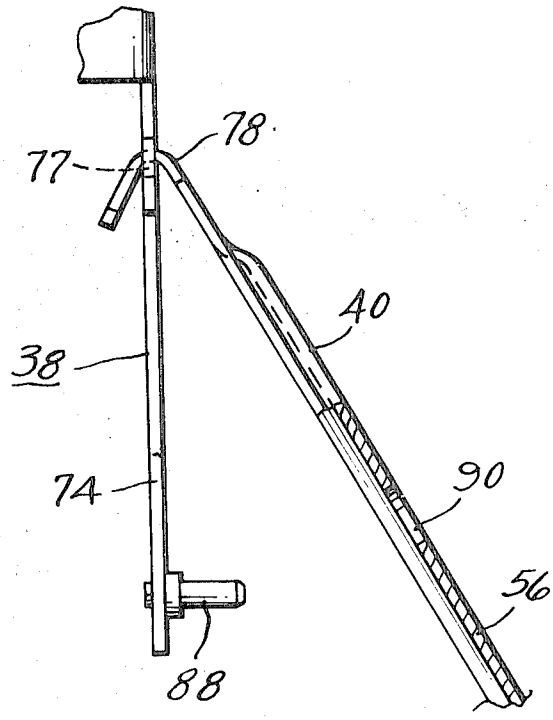
[57] **ABSTRACT**

A pendulum clock powered by direct current wherein a pendulum is functionally separated from a timekeeping movement which drives the hands of the clock. The pendulum is driven by a separate electromagnetic movement which applies a drive force very close to the fulcrum of the pendulum so that a long pendulum arm and bob may be displayed without viewing the drive mechanism.

7 Claims, 6 Drawing Figures



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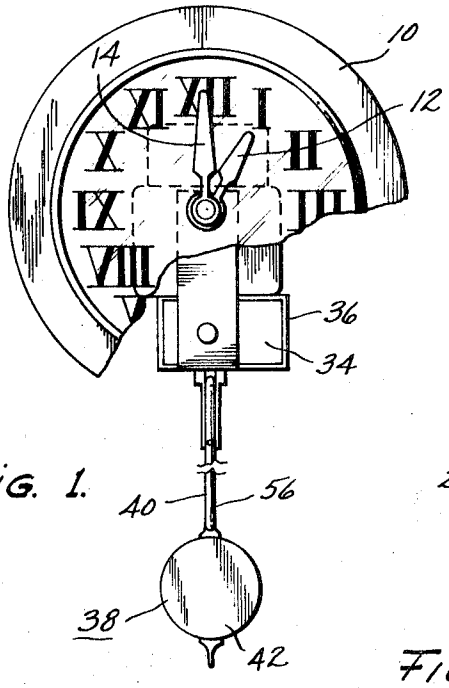

FIG. 1.

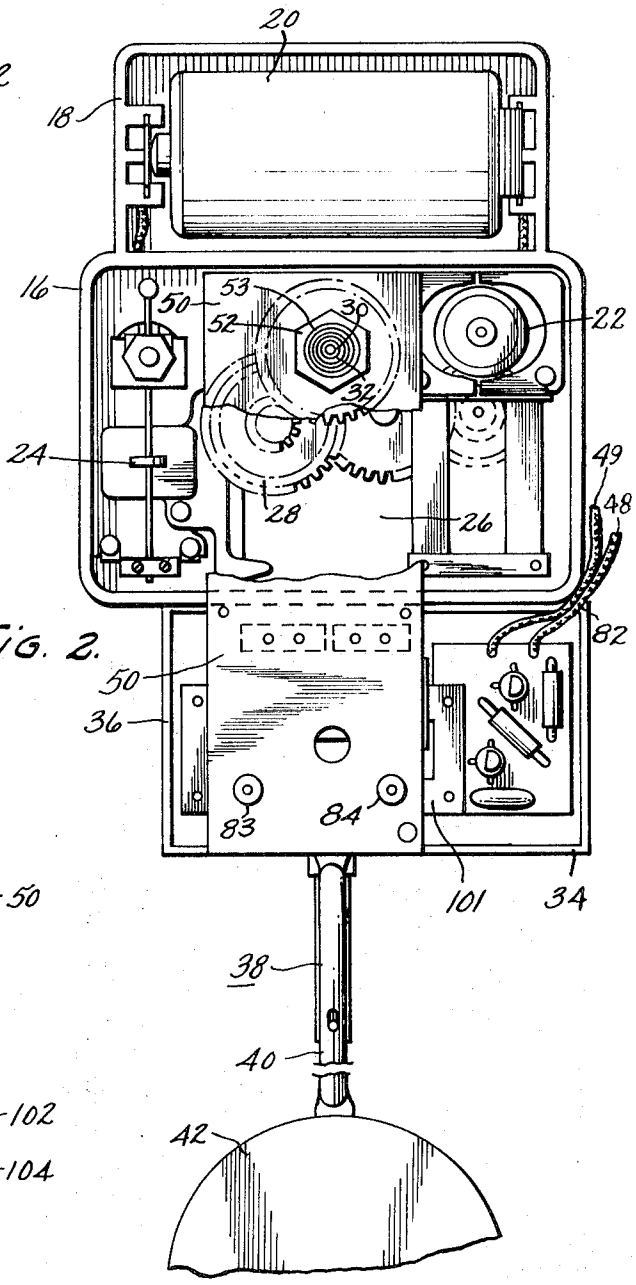

FIG. 2.

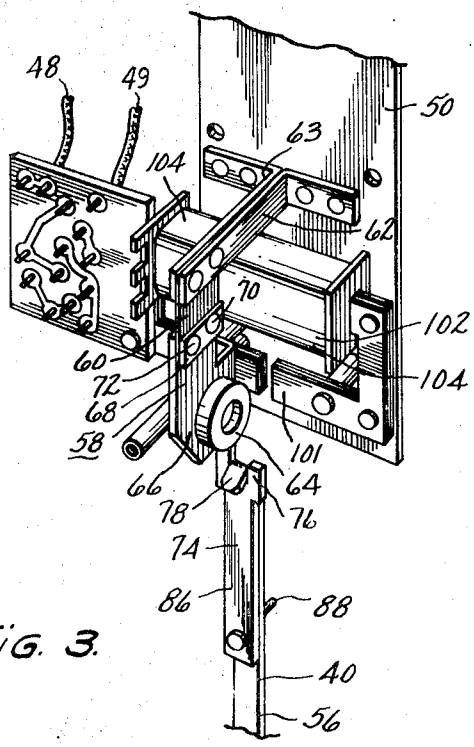

FIG. 3.

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FIG. 4.

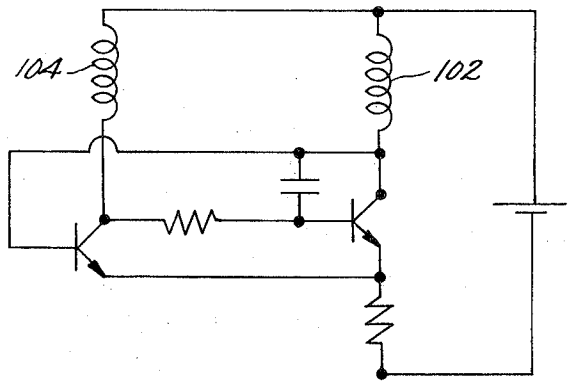


FIG. 5.

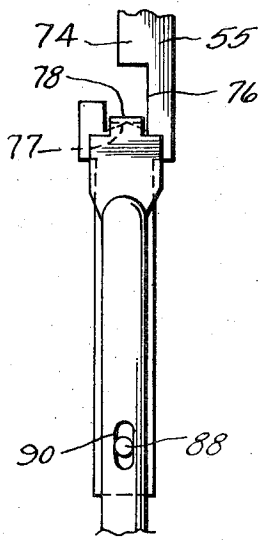
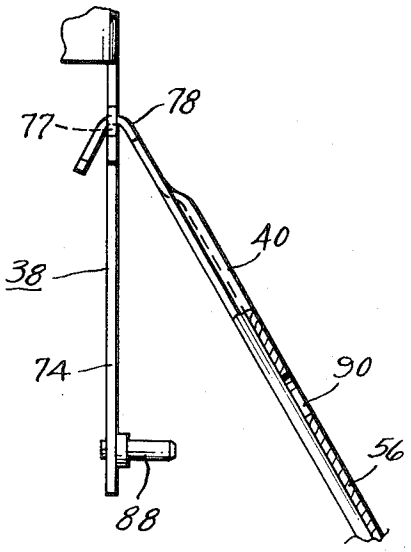


FIG. 6.



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SIMULATED PENDULUM CLOCK

BACKGROUND OF THE INVENTION

This invention relates to a direct current pendulum clock, and more particularly, to a pendulum clock wherein a uniquely constructed pendulum is driven by an electromagnet movement which is separate from a timekeeping movement which drives the hands of the clock.

Most contemporary battery-operated clocks include a low power electronic timekeeping movement which is adequate for driving the hands of a clock, and while such a clock movement is entirely satisfactory for the functional purpose of timekeeping, the timekeeping motor or movement is not capable of driving a relatively large ornamental pendulum.

Old-fashioned swinging pendulum clocks wherein a pendulum is structurally integrated into the clock mechanism to perform a timekeeping function are still considered by the clock industry to be asthetically appealing to a significant number of people. Accordingly, some contemporary prior art pendulum clocks have the appearance and apparent external operation of an old-fashioned swinging pendulum clock, and yet the pendulum does not serve a timekeeping function. Most of these contemporary pendulum clocks have included a synchronous electric motor which utilizes the ordinary house wiring as a source of electric power, and all of these prior art simulated pendulum clocks have used the same motor that is used for timekeeping to provide the power to drive the pendulum. For example, in a prior U.S. Pat. No. 2,995,005 to Boyles, dated Aug. 8, 1961 and assigned to the same assignee as the present invention, there is disclosed a simulated swinging pendulum clock in which an electric motor 14 is provided for driving the hands of the clock and also the pendulum of the clock. Such a prior art simulated pendulum clock mechanism requires a relatively high torque motor to drive both the hands of the clock and the pendulum.

The pendulum in an old-fashioned swinging pendulum clock normally requires considerable attention since it is a functional part of the clock. For example, it is very important that the pendulum be in a vertical position and adjusting screws are usually provided for this purpose. In addition, the length of the pendulum usually requires adjustment. For instance, for an adjustment of 1 minute per week, a 12 inch pendulum must be adjusted to within 0.003 inch of the correct length.

With these considerations in mind, it is a particular object of this invention to provide a simulated pendulum clock wherein the pendulum is less sensitive to the operating position of the clock, does not require a length adjustment, and is constructed to be operated independently of the timekeeping movement with low battery power.

It is also an object of this invention to provide a pendulum clock wherein pendulums of different lengths and shapes can be used without making any change to the timekeeping movement or to the pendulum movement.

SUMMARY OF THE INVENTION

In accordance with one of the aspects of this invention, a timekeeping movement is provided for driving the hands or other time display elements of a clock, and the pendulum for the clock is positioned below the timekeeping movement. The pendulum includes a fulcrum portion, an upper drive arm, a lower elongated viewable arm, and a pendulum bob. An electromagnetic movement which is separate and distinct from the timekeeping movement is positioned below the timekeeping movement for driving the pendulum. The electromagnetic pendulum movement is located adjacent to the upper drive arm of the pendulum for applying a drive force to the pendulum very close to the fulcrum portion of the pendulum while the lower viewable pendulum arm and bob extend a substantial distance below the electromagnetic pendulum movement.

With this construction, the movement for driving the hands of the clock, the movement for driving the pendulum, and the upper pendulum arm may all be located behind the face of the clock so that they cannot be seen by anyone viewing the clock and the pendulum; while the lower pendulum arm and bob may be readily seen as they extend below the face of the clock. It can be appreciated that with this arrangement any number of different lengths and shapes of lower pendulum arms and bobs may be connected to the upper pendulum arm to be driven by the separate and distinct pendulum drive movement.

In addition, while the electronic movement for driving the pendulum is separated from the electronic timekeeping movement, since it is physically located immediately below the electronic movement for driving the hands of the clock, it may use the same battery which is utilized for powering the hands of the clock.

Moreover, with this construction the simulated pendulum drive mechanism is not sensitive to the position of the clock, and since the pendulum does not have any relationship to the timekeeping function of the clock it does not require a length adjustment.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and attendant advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a front elevational view of my improved pendulum clock partly broken away to show details of construction;

FIG. 2 is a front elevational view of the battery operated pendulum movement and the pendulum of the clock shown in FIG. 1;

FIG. 3 is a perspective view of a portion of the pendulum and the electromagnetic movement for driving the pendulum of the pendulum clock shown in FIG. 1;

FIG. 4 shows an electronic circuit for delivering driving pulses to the pendulum for moving the pendulum;

FIG. 5 is an enlarged fragmentary front elevational view of the upper and lower arms of the pendulum; and

FIG. 6 is an enlarged fragmentary side elevational view of the upper and lower arms of the pendulum similar to FIG. 5 showing the lower arm of the pendulum being connected to the upper arm of the pendulum.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and first particularly to FIG. 1, there is shown a pendulum clock which includes my unique pendulum and pendulum movement construction. In the embodiment illustrated, the clock includes an ornamental casing 10 of a type which is capable of being hung from a wall. A conventional hour

hand 12, a minute hand 14, and Roman numerals are provided for indicating the hours and minutes.

The hands of the clock may be driven by any conventional timing mechanism 16, and as shown in FIG. 2, an electronic battery-powered movement is utilized for this purpose. The battery-powered movement includes a casing 18 which may be conveniently formed from plastic or other suitable material. A battery 20 is positioned in an upper portion of the casing, and an electric motor 22, a mechanical oscillator 24, and an electronic oscillator circuit 26 are positioned in the lower portion of the casing along with drive gearing 28 for the hands of the clock. It can be appreciated that the gearing from the motor 22 is connected to a center stack of concentric shafts 30 and 32 which extend through a front wall of the timing mechanism casing and the front casing 10 of the clock for driving the hour and minute hands 12 and 14, respectively.

The specific electronic battery-operated clock movement illustrated does not form a part of my invention and is described and shown in greater detail in a prior patent of C. M. Jones U.S. Pat. No. 3,454,856, issued July 8, 1969, and assigned to the same assignee as the instant invention. In accordance with my invention, a pendulum and a movement for driving the pendulum may be readily added to the clock mechanism so far described, or any other clock mechanism which includes a low power direct current source of power.

With particular reference to FIG. 1, it can be appreciated that the usual electronic battery-operated timekeeping movement 16 for driving the hands of a clock is not too large, and yet as shown by the dotted lines it occupies a considerable amount of space behind the front face of the clock. As shown, it extends roughly from the lower portion of Roman numeral I to the upper portion of numeral VII. As shown, I have provided an electronic pendulum movement 34 which may be positioned with a casing 36 which is so small that it does not extend below the outer circumference of the clock casing 10. In this manner, all of the driving mechanism for my unique pendulum 38 may be positioned so that it is not seen. Thus, a person viewing the pendulum clock may readily observe the hands of the clock and what appears to be an old-fashioned swinging pendulum with a relatively long pendulum arm 40 and a large decorative pendulum bob 42.

Since the battery-powered pendulum movement 34 is separate and distinct from the timekeeping mechanism 22, 24 and 26 for driving the hands of the clock, it can be conveniently housed in a separate plastic casing 36. As shown, the electrical connections from the battery 20 to the separate pendulum movement 34 may be conveniently made by a pair of electrical wires 48 and 49 which may extend through an aperture 82 which is formed in a top wall of the casing 36.

The pendulum movement casing 36 may be readily attached to the conventional battery-operated clock timing mechanism by means of a sheet metal plate 50 which may be conveniently secured to the mechanism casing by a nut 52 and a threaded collar 53 which are also required for assembling the timekeeping movement casing 16 to the clock casing 10. As illustrated, the sheet metal plate 50 extends downwardly from the collar 53, and the pendulum movement casing 36 may be readily attached to the plate 50 by any suitable connection means.

In accordance with my invention, the pendulum 40 is uniquely constructed so that a variety of different ornamental pendulums may be operated and driven by one mass-produced pendulum movement 34, and the pendulum arm which is visible is also uniquely constructed so that it will always hang in a more or less vertical position regardless of slight inaccuracies which might occur in mounting the clock casing 10 on a wall, or similar inaccuracies which could occur with table top type clocks. To achieve these objectives, the pendulum 40 is formed in two parts, a lower portion including a relatively long ornamental arm 56 to which a decorative pendulum bob 42 may be attached, and a very short upper portion including a fulcrum portion 60 and a drive arm 58 which is operated by the pendulum drive movement 34.

As shown, the fulcrum portion includes a flexible leaf spring 60 having its upper end clamped between two L-shaped brackets 62 and 63 which may be riveted or otherwise secured to the sheet metal plate 50.

In order to be able to utilize a relatively low power drive mechanism, the fulcrum spring 60 of the pendulum is made quite thin. In the preferred embodiment illustrated in FIG. 3, the hinge spring is a piece of hardened steel of a thickness of approximately 0.0015 inch and an active length of one-fourth inch. The spring flexes as the pendulum swings at its characteristic varying angular acceleration. This varying angular acceleration would result in an awkward appearing motion because the loosely hung light-weight pendulum arm 40 would rock in the hanger bracket 74 and it would not stay in alignment with the drive arm 58. To overcome any such awkward motion, the bracket 74 to which the lower pendulum arm 40 is hung is provided with a unique support and connecting mechanism to support the weight of the pendulum only at the center of the pendulum shaft.

As shown in FIG. 3, the upper drive arm 58 includes a bracket member portion 66 which is provided for supporting the lower arm 56 and also functions as a mounting bracket for supporting a permanent magnet 64 for driving the pendulum. The bracket portion 66 is arranged in the same plane as the fulcrum spring 60 and its upper end is readily attached to the fulcrum spring by means of a plate 68 and rivets 70 and 72. The lower leg portion 74 of the upper drive arm 58 is arranged generally perpendicular to the leg 66 and is uniquely constructed to support the lower ornamental pendulum arm 56 in a vertical position.

In accordance with my invention, the lower pendulum arm 56 is hung in a vertical position from the upper arm 58 by uniquely constructing the connecting portions of the arms. As illustrated more particularly in FIGS. 5 and 6, the upper arm 74 includes a slotted portion 76 having an upwardly extending projection 77 for receiving a tab 78 of the lower arm for providing a gravitational point support for the lower pendulum arm 40. With particular reference to FIGS. 6, 5 and 3, it can be seen that a hooked tab 78 of the lower arm 40 includes a generally flat surface which is positioned on top of the gravitational point support surface 77 of the upper pendulum arm 58. By this arrangement, the pendulum bob 42 and the lower pendulum arm 40 will hand in a generally vertical position from the gravitational point support 77 regardless of slight inaccuracies in supporting the clock casing 10 on a wall or other support. Should the clock casing 10 be positioned so

that its top is forward of a true vertical position and its bottom portion is rearward from a true vertical position, it can be appreciated that the lower arm 40 and bob 42 would be located somewhat forwardly from the lower portion 86 of the drive arm member 58.

With particular reference to FIG. 3, the pendulum drive movement 34 is inductively coupled to the pendulum magnet 64 and will cause the upper arm 58 of the pendulum to be moved to and fro to the right and left as shown in the drawings about its fulcrum spring 60.

The details of the pendulum driving system do not form a part of this invention and are described and illustrated in greater detail in a co-pending application of Christie Petrides (6D-4381), Ser. No. 211,578, assigned to the same assignee as the present invention.

As described in more detail in the aforementioned application, since the pendulum drive movement 34 is essentially an appendage to the battery-operated timekeeping movement 16, the available space from the leaf spring fulcrum 60 to the point where the pendulum receives its drive power is very limited and may be less than 1 inch. At this distance from the fulcrum, the magnet 64 excursion may be as small as 0.1 to 0.2 inch. Moreover, the magnet 64 fixed to the pendulum arm 58 at this point may be moving with a frequency of only one cycle per second. Thus, the magnet has been designed to have a very high flux density and is coupled to a large coil having many turns. The motor stator magnet core and energizing coil for supplying adequate flux to move the permanent magnet 64 are shown at 101 and 102, respectively, in FIG. 3 of the drawing, and the drive coil 102 is also shown in the electronic circuit illustrated in FIG. 4 of the drawing.

The circuit illustrated in FIG. 4 is essentially a push-pull switching oscillator circuit which is turned on and off by signals generated by the swinging magnet 64 on the upper pendulum arm 58. To achieve this, coils 102 and 104 may be wound on the same bobbin for alternately driving magnet 64 and the pendulum.

In accordance with my invention, the upper pendulum arm 58 is uniquely constructed with respect to the lower pendulum arm 56 for transmitting the drive forces from the permanent magnet 64 to the upper pendulum arm 58, and to the lower pendulum arm 56 and the pendulum bob 42. As illustrated more particularly in FIGS. 3, 6 and 7, an outwardly extending drive pin 88 is fixed to the lower portion 74 of the drive bracket member for cooperating with an elongated slot 90 which is formed in the lower pendulum arm 56. With this arrangement, the drive pin 88 exerts an aligning force on the lower pendulum arm 56 and the pendulum bob 42, and it also allows the pendulum arm 40 and the pendulum bob 42 to hang in a more or less true vertical position regardless of the position of the clock casing 10. The pin and slot connection 88–90 allows the lower pendulum arm 56 and the pendulum bob 42 to hang away from the lower portion of the driving bracket member 74 starting at the gravitational point support surface 77 where the lower arm 40 of the pendulum arm engages the upper pendulum arm 58.

With particular reference to FIGS. 6 and 3, it can also be appreciated that the tab portion 78 of the lower pendulum arm 56 is positioned at an angle to the major portion of the lower pendulum arm 56 in order to urge the lower pendulum arm 56 toward the lower leg 74 of the drive bracket.

As shown in FIG. 3, it can be appreciated that the pin 88 extends outwardly from the hanger bracket 74 of the upper pendulum arm into the mating slot 90 in the pendulum shaft. Thus, it provides a positive alignment of the pendulum arm 56 with the driving bracket 74 so that both the upper and lower pendulum arms 58 and 56, respectively, are forced to swing with the same angular velocity so that no rocking motion can occur. Also, the pin 88 engages in the slot 90 in the lower pendulum arm with a 0.001 or 0.002 inch clearance so that the pendulum shaft can hang freely in its gravitational vertical position regardless of whether the clock is mounted in the same or a varying position from the vertical.

From the foregoing description, it will be appreciated that my unique pendulum mechanism may be readily operated as a true pendulum with its pleasing swinging motion. The pendulum mechanism is not sensitive to the operating position of the clock, it does not require a length adjustment, and the mechanism may be used with any number of different timekeeping movements and many different pendulums having a number of different pendulum arm lengths without any change to the timekeeping movement or to the pendulum movement. Moreover, the electromagnetic drive for the upper arm of the pendulum is applied so close to the fulcrum portion of the pendulum that the portion of the lower pendulum arm and the pendulum bob may be visible substantially in their entirety and may be made quite long while the relatively small drive mechanism 34 may be conveniently shielded from an observer by a clock casing.

It can also be appreciated that my unique pendulum construction is particularly suitable to relatively large but light-weight ornamental pendulums because the short radius of the applied driving force would require the pendulum arm and bob assembly to be as light in weight as is practical. Normal pendulum clocks have a relatively heavy bob which allows a simple hook attachment means to be satisfactory for connecting the pendulum to its support. Thus, there is a substantial difference between the conventional pendulum clocks with their heavy pendulum bobs which are sensitive to the operating position of the clock and require very precise length adjustments, and my improved pendulum construction.

I claim:

1. A low power direct current operated pendulum clock comprising:

a. a timekeeping movement;

b. a time display mechanism operatively connected to said timekeeping movement to display time;

c. a pendulum including an elongated arm and a pendulum bob, said bob being connected to said elongated arm, said elongated arm and bob being positioned below and separated from said timekeeping movement;

d. an electromagnetic movement including an oscillator for providing pulses for driving said pendulum, said electromagnetic movement being separate from said timekeeping movement and having no electrical, mechanical or synchronizing driving connection with said timekeeping movement;

e. a source of electrical energy for driving said electromagnetic movement, said electromagnetic movement having an electrical connection with said source of electrical energy; and

f. said pendulum arm including an upper pendulum drive arm having a permanent magnet positioned adjacent to said electromagnetic movement for driving said pendulum and a lower pendulum arm removably connected to said upper pendulum arm.

2. A direct current pendulum clock as defined in claim 1 wherein the upper pendulum arm includes a gravitational point support surface integrally formed with the upper arm and a drive connection extending outwardly therefrom for driving the lower arm and the bob of the pendulum.

3. A pendulum clock as defined in claim 2 wherein the lower removable arm of the pendulum includes an inwardly extending tab which is located at an angle with respect to the gravitational point support surface of the upper arm in order to urge the lower pendulum arm toward the upper pendulum arm.

4. A pendulum clock as defined in claim 3 wherein a vertical slot is formed in the lower arm of the pendulum, a drive pin is fixed to the upper arm of the pendulum and the pin extends into the generally vertical slot for driving the lower pendulum arm and allowing the lower pendulum arm to hang in a generally vertical position from its tab which is positioned on the gravitational point support surface of the upper pendulum arm.

5. A pendulum clock as defined in claim 1 wherein said timekeeping movement is enclosed in a plastic casing, said pendulum movement is enclosed in a plastic casing, and a sheet metal plate is provided for connecting the pendulum movement to the timekeeping movement and to a clock casing.

6. A pendulum clock as defined in claim 1 wherein the pendulum includes a fulcrum portion which is formed from a flexible leaf spring which is rigidly connected to the upper pendulum arm.

7. A pendulum clock as defined in claim 5 wherein said leaf spring is arranged in a plane which is generally perpendicular to the plane of the lower pendulum arm.

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