P. A. BENTLEY.

ELECTRICALLY DRIVEN CLOCK.

APPLICATION FILED JUNE 22, 1911.

1,043,663.

Patented Nov. 5, 1912.

2 SHEETS—SHEET 1.

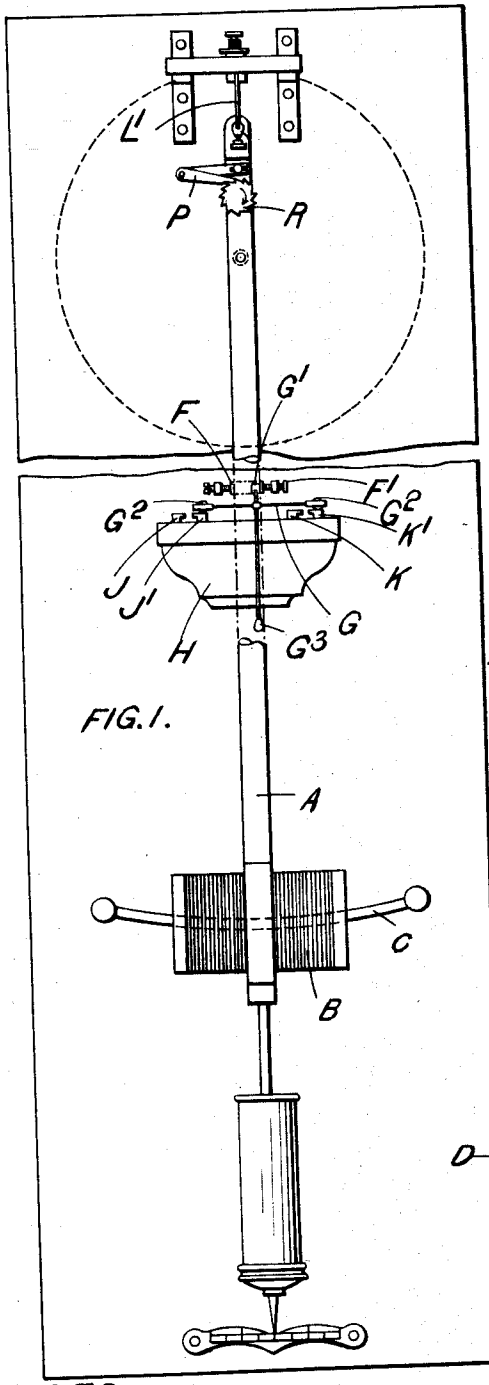


FIG. 1.

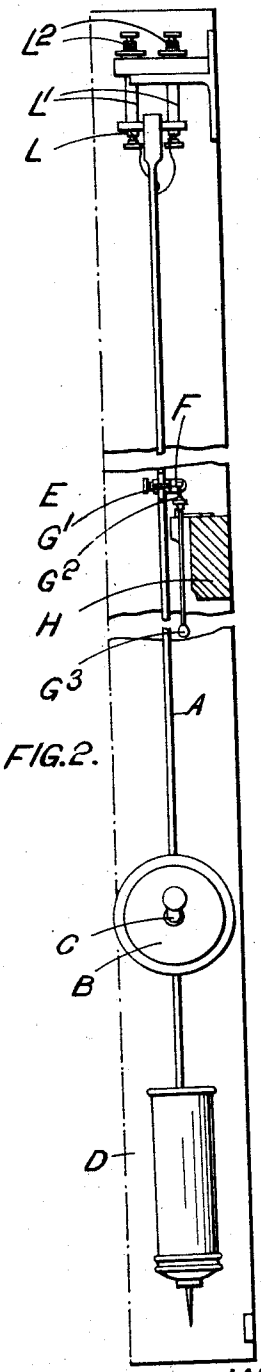


FIG. 2.

WITNESSES.

Thomas Durant

Halbert P. Brown

INVENTOR.

Percival Arthur Bentley,

By Church & Church

his Attys.

P. A. BENTLEY.

ELECTRICALLY DRIVEN CLOCK.

APPLICATION FILED JUNE 22, 1911.

1,043,663.

Patented Nov. 5, 1912.

2 SHEETS—SHEET 2.

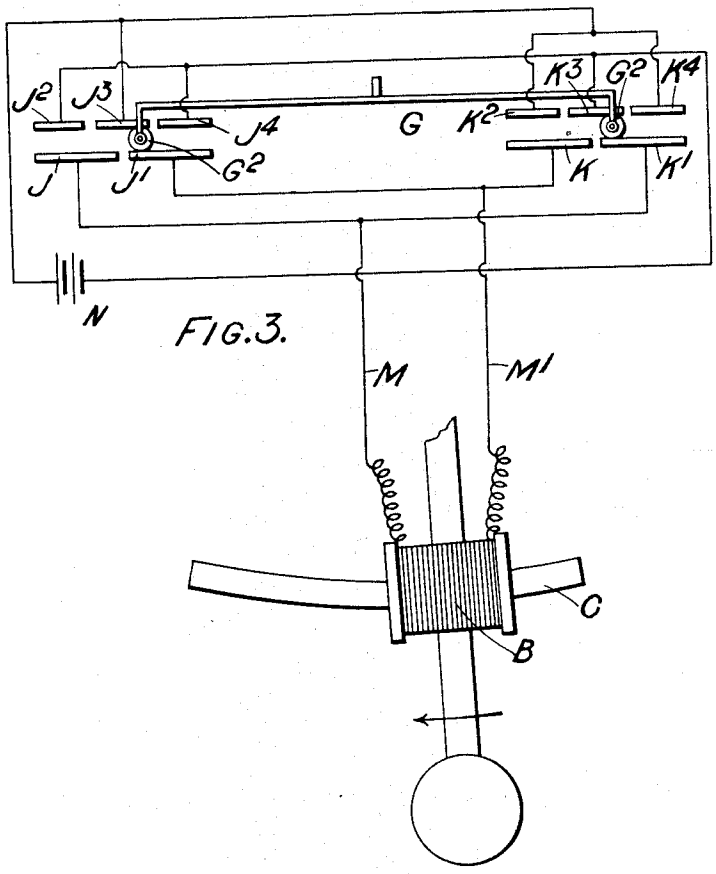
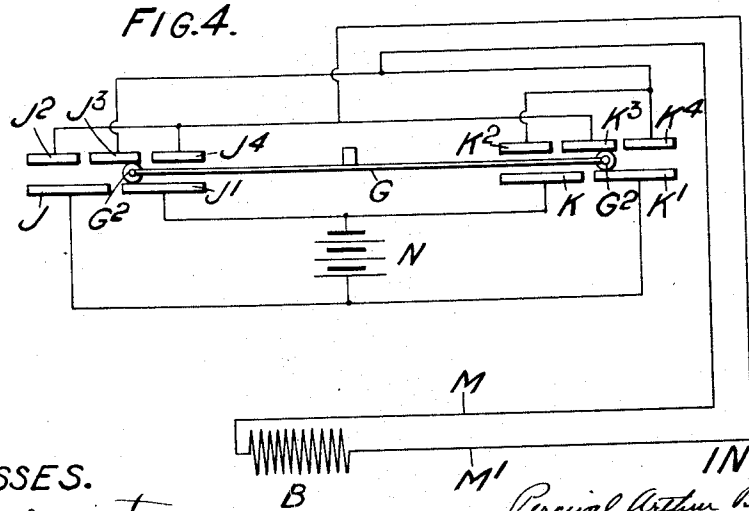


FIG. 3.

FIG. 4.



WITNESSES.

Thomas Durant

Walter P. Brown.

INVENTOR.

Percival Arthur Bentley

By Church & Church

his Attys

UNITED STATES PATENT OFFICE.

PERCIVAL ARTHUR BENTLEY, OF BURTON-UPON-TRENT, ENGLAND.

ELECTRICALLY-DRIVEN CLOCK.

1,043,663. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed June 22, 1911. Serial No. 634,688.

To all whom it may concern:

Be it known that I, PERCIVAL ARTHUR BENTLEY, a subject of the King of England, and residing at Burton-upon-Trent, Staffordshire, in England, have invented certain new and useful Improvements in Electrically-Driven Clocks, of which the following is a specification.

This invention relates to electrically driven clocks and has particular reference to clocks of the type in which an impulse is given to the pendulum by electromagnetic apparatus such for example as a coil of wire carried by the pendulum and coöperating with a fixed magnet or vice versa, a current being caused to flow through the coil from a battery and set of contacts controlled by the pendulum itself.

The primary feature of the present invention is that the contacts are so arranged that if the amplitude of the swing of the pendulum increases above the normal, the current is caused to exert a retarding force on the pendulum as it commences its next swing, the amplitude of the swing being thus maintained practically constant. This is conveniently carried out by providing the contacts, which may be in the form of fixed rails or bars coöperating with rolling or other moving contacts, with auxiliary or reversing sections so that the current, instead of helping the pendulum forward on its downward swing, tends to retard that motion in any instance where the previous swing has been of an amplitude above the normal.

In the accompanying drawings which illustrate one construction of an electrically driven clock according to this invention, Figure 1 is a front elevation showing the pendulum and contacts, Fig. 2 is a side elevation looking from right to left in Fig. 1, parts being shown in section. Fig. 3 is a diagram showing the electrical connections on a larger scale, and Fig. 4 is a similar diagram showing the connections somewhat modified.

Like letters indicate like parts throughout the drawings.

With reference to Figs. 1 and 2, the pendulum A carries a coil B adapted to encircle and swing over a permanent magnet C fixed to a back-board or support D. Attached to the pendulum A as by a screw E is a U-shaped member or frame F having adjustable screws or tappers F′. Between these tappers and in their path as they are reciprocated by the swing of the pendulum A is a projection or head G′ forming part of a carriage G having contact wheels or runners G^2 and kept in a vertical position by means of a pendant weight G^3. The contact wheels G^2 run in the spaces between two sets of relatively fixed contact rails or bars supported on a bracket H. Each set of rails as may be seen more clearly by reference to Fig. 3, consists of two front sections J, J′ and K, K′ respectively and three rear sections lettered respectively J^2, J^3, J^4, K^2, K^3, K^4, and when the wheels G^2 are in position between the rails, they make electrical connection between the particular front and rear sections upon which they may be standing. The carriage itself may be made of insulating material or the wheels or runners G^2 may be insulated from it, for the carriage is simply intended as a mechanical connection to maintain the runners G^2 at a fixed distance apart and to cause them to move backward and forward along the two sets of rails.

The ends of the coil B are connected by light wires which may be taken up the pendulum rod to terminals L which are in connection through the pendulum suspension springs L′ with other terminals L^2. These terminals L^2 are connected, one to the two inner sections J′ and K of the front rails and the other to the two outer sections J and K′. In Fig. 3 these connections are shown clearly as a diagram, the terminals being left out and the ends of the coil B represented as connected directly by conductors M, M′ to the outer and inner sections J, K′ and J′, K respectively. The central section J^3 of one set of rear rails is joined to one pole of a battery N or other source of current and is also connected to the inner and outer sections K^2, K^4 of the other set of rails. Similarly the central section K^3 is joined to the other pole of the battery N and to the two outer sections J^2, J^4. All these connections are shown in the diagram forming Fig. 3.

When the swing of the pendulum is normal, the wheel G^2 on the left hand side of the carriage G as seen in Fig. 3 will remain in contact with the central section J^3, the movement of the carriage being only sufficient to cause the wheel to travel from the position shown, where it makes contact between the sections J^3 and J′, to another

position on the other side of the gap between the sections J and J′ where it connects the section J^3 with the section J. Similarly with a normal swing of the pendulum, the other wheel G^2 on the right hand side of Fig. 3 first connects the section K^3 with the section K′ and is then moved by the swing of the pendulum so that the section K^3 is connected to the section K. This normal movement simply causes a reversal of the current in the coil B by connecting the same pole of the battery N first to one end of the coil and then to the other end, the arrangement being simply a form of reversing switch. The current being thus reversed through the coil at the proper time toward the end of the swing of the pendulum, the reaction between the magnetic field of the coil and that of the magnet C results in a force tending to help the motion of the pendulum due to gravity. The backward and forward swing of the pendulum is transmitted to the clock train through any suitable mechanism such for example as the pawl P and the ratchet wheel R, but the details of this mechanism form no part of the present invention.

Suppose now that the pendulum be swinging in the direction of the arrow in Fig. 3 and that the amplitude of that swing is greater than the normal, the carriage G, and consequently the wheels G^2, will be moved farther to the left than they would be in normal circumstances. Consequently the wheels G^2 will break connection with the central sections J^3 and K^3 and will be carried over the gap on to the extreme left hand sections J^2 and K^2 connecting those sections with the front sections J and K. But as will be seen from Fig. 3, the outer sections J^2, J^4 and the central section K^3 are connected to one pole of the battery while the central section J^3 and the outer sections K^2 and K^4 are connected to the other pole. Therefore the result of this extreme movement to the left is to re-make the connection with the coil B as the pendulum begins to swing back from left to right in such a way that the current in the coil is in the same direction as when the pendulum was making the first part of its stroke from right to left. In other words, the current will be in such a direction as to exert a retarding force upon the pendulum. Similarly if the amplitude of the swing of the pendulum when going from left to right should be greater than the normal, the carriage G will be carried to the right hand and will bring the wheels G^2 into such a position that they connect the sections J^4 and K^4 to the sections J′ and K′, and in this case the current established in the coil B as the pendulum begins to swing from right to left will tend to retard it and restore the amplitude of the swing to the normal. In this manner it will be seen that any tendency to an increase in the amplitude of the swing is checked and such amplitude is maintained practically constant.

The relatively fixed contact rails may be mounted on sliding pieces or otherwise on the bracket H so that their position with regard to the vertical line of the pendulum may be capable of adjustment.

It will be obvious that the connections of the coil B and the battery N may be reversed so far as the two sets of rail contacts are concerned, for example, the ends of the coil B might be connected through the wires M, M′ to the rear rails J^2, J^3, J^4 and K^2, K^3, K^4 and the battery N connected between the inner sections J′ and K and the outer sections J and K′ of the front rails. Such a method of connection is shown diagrammatically in Fig. 4 and its operation will be precisely similar to that described with reference to Fig. 3.

In the construction shown in Figs. 1 and 2, the wheels G^2 are intended to rest upon and make contact between the two sets of rails beneath them, but obviously any suitable arrangement of moving and fixed contacts may be employed. For example, the rail formed of three sections may be above that formed of two sections and the wheel G^2 may run between them and make connection in that way. The diagrams forming Figs. 3 and 4 may be taken to represent such a modified arrangement of rails although they also show diagrammatically the electrical connections for the construction described with reference to Figs. 1 and 2. It will be understood that the wheels G^2 represent some convenient form of moving or rolling contact, but any well known form of such contact may be employed, such for instance as a sliding contact. It is, however, preferred to use a rolling contact in order that the arrangement shall be free from unnecessary friction.

Any source of electrical energy may be used to furnish current for the coil B, and it is found in practice that sufficient current may be obtained from a battery consisting of elements of zinc and carbon embedded in the earth.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an electrically driven clock, the combination with the pendulum, electromagnetic means for actuating said pendulum, a source of current and means controlled by the pendulum itself for maintaining the current in the same direction during the swing of the pendulum in both directions when the amplitude of the swing is above the normal in either direction.

2. In an electrically driven clock, the combination of a pendulum, electromagnetic means comprising a magnet and coil for actuating the pendulum, a source of current,

circuits connecting such source of current with the coil, a switch controlling said circuits and adapted to be moved by the pendulum so as to reverse the current in the coil at each normal swing of the pendulum and auxiliary circuits also controlled by the switch whereby if the amplitude of the swing increases above the normal, the direction of the current is restored to normal so that a retarding force is exerted upon the pendulum.

3. In an electrically driven clock the combination of a pendulum, electromagnetic means comprising a magnet and a coil for actuating the pendulum, a source of current, rail or bar contacts, circuits connecting the source of current and the coil with the rail contacts, a switch movable by the pendulum and coöperating with the contacts so that with a normal swing the current in the coil is reversed at each swing of the pendulum, and auxiliary contacts brought into operation when the amplitude of the swing of the pendulum exceeds the normal whereby the current is allowed to flow through the coil in such a direction as to exert a retarding force upon the pendulum.

4. In an electrically driven clock the combination of a pendulum, a magnet mounted adjacent to the path of motion of the pendulum, a coil mounted on the pendulum in proximity to the magnet, a source of current, rail or bar contacts, circuits connecting the source of current and the coil with the rail contacts, a switch movable by the pendulum and coöperating with the contacts so that with a normal swing the current in the coil is reversed at each swing of the pendulum, and auxiliary contacts brought into operation when the amplitude of the swing of the pendulum exceeds the normal, whereby the current is allowed to flow through the coil in such a direction as to exert a retarding force upon the pendulum.

5. In an electrically driven clock, the combination of a pendulum, a carriage moved by the pendulum, two contact-making wheels mounted on the carriage and a set of contact rails coöperating with each wheel each set comprising rails of three sections and two sections which are connected by the wheel, a pendulum-actuated coil, a source of current, and connections between the rails, the source of current and the coil such that with a swing of normal amplitude, the current in the coil is reversed for each swing of the pendulum, but if the amplitude increases, the direction of the current is restored to normal so that a retarding force is exerted on the pendulum.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

PERCIVAL ARTHUR BENTLEY.

Witnesses:
B. E. DUNBAR KILBURN,
ARCHIBALD J. FRENCH.