H. E. WARREN.
CLOCK MECHANISM.
APPLICATION FILED NOV. 30, 1914.

1,160,346.

Patented Nov. 16, 1915.
3 SHEETS—SHEET 1.

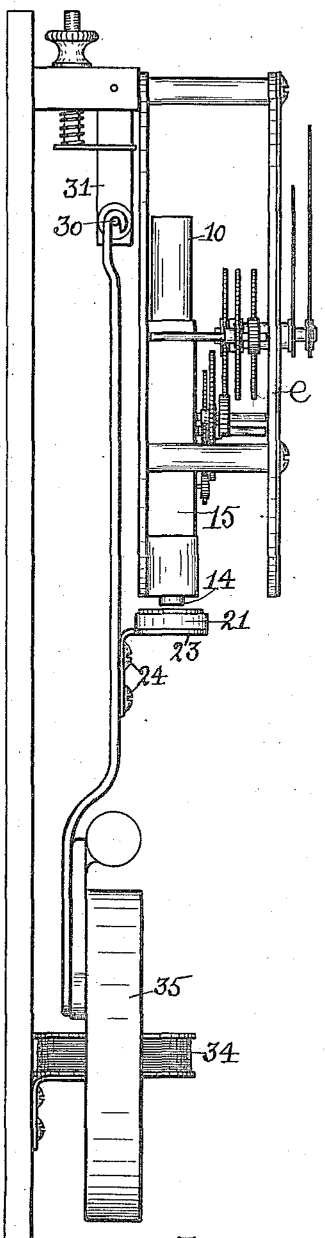

Fig. 1.

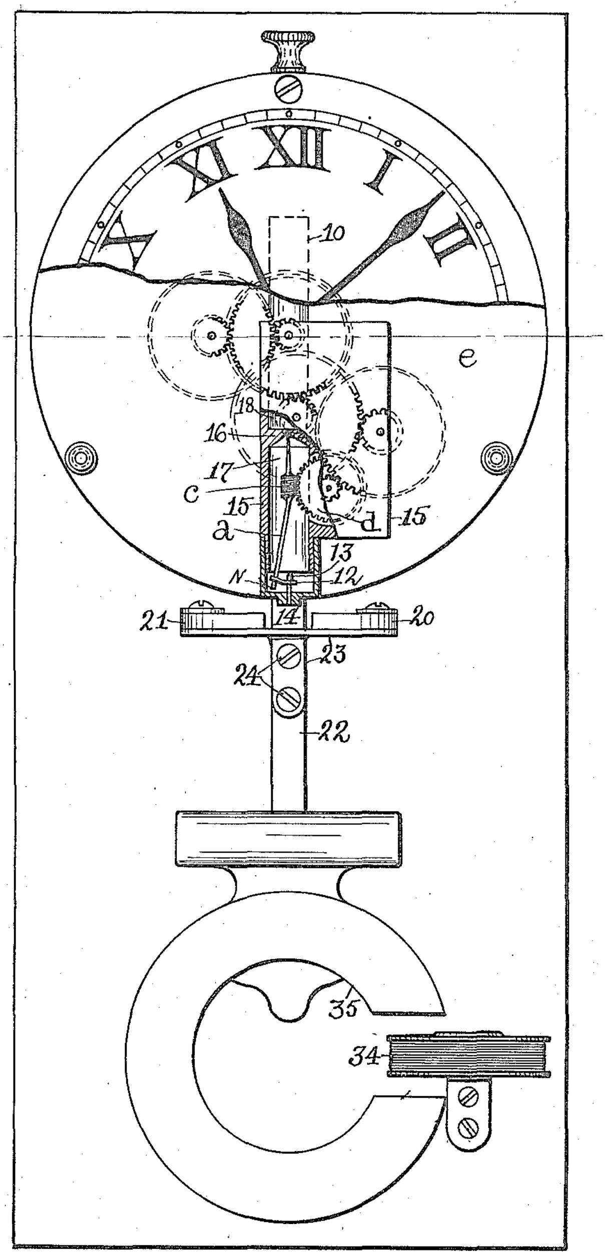

Fig. 2.

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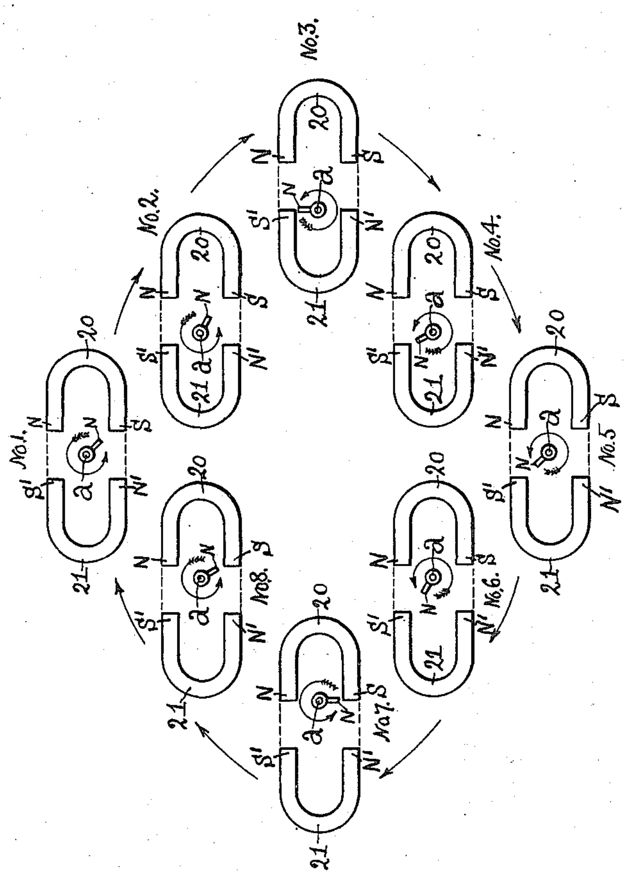

Fig. 4

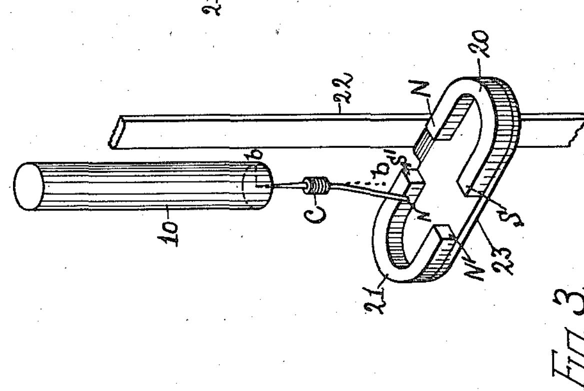

Fig. 3

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3 SHEETS—SHEET 3.

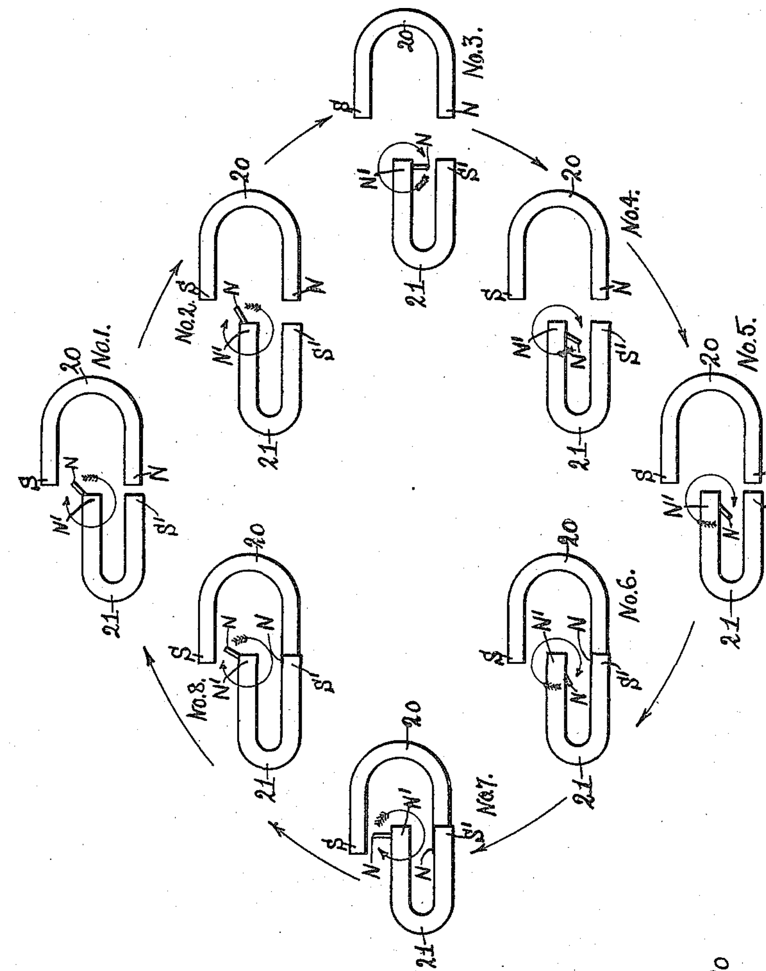

Fig. 6

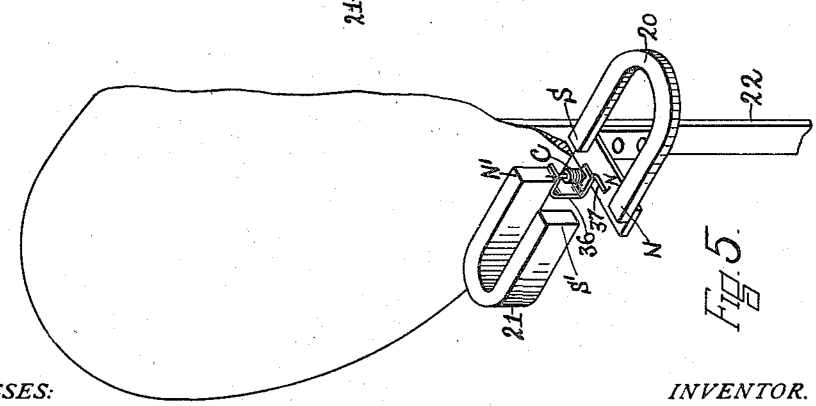

Fig. 5

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CLOCK MECHANISM.

1,160,346. Specification of Letters Patent. Patented Nov. 16, 1915.

Application filed November 30, 1914. Serial No. 874,629.

To all whom it may concern:

Be it known that I, Henry E. Warren, a citizen of the United States, residing in Ashland, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Clock Mechanism, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to a clock mechanism of that class in which an oscillating pendulum is employed, and has for its object to provide the clock mechanism with means for directly transforming the oscillations of the pendulum into motion of continuous rotation, whereby the oscillating pendulum is employed as the driving member for the time train, yet is mechanically disconnected from the time train, which is especially advantageous in portable clocks, such for instance as the type commonly known as mantle clocks, as the pendulum or the works of the clock are capable of being removed from the clock when it is desired to move, ship or transport the clock and can be replaced by unskilled labor without danger of disarrangement of the clock which would interfere with its accuracy.

In the present instance I have shown the invention as embodied in a clock in which the pendulum is mechanically disconnected from the time train but is magnetically coupled thereto so as to produce rotation of the time train by reciprocation or oscillation of the pendulum.

These and other features of the invention will be pointed out in the claims at the end of this specification.

Figure 1 is a side elevation and Fig. 2, a front elevation of a clock embodying this invention. Fig. 3, a detail of the magnetic coupler shown in Fig. 1. Fig. 4, a diagrammatic view to illustrate the action of the magnetic coupler. Fig. 5, a modified form of magnetic coupler, and Fig. 6, a diagrammatic view to illustrate the action of the magnetic coupler shown in Fig. 5.

Referring to Figs. 1 to 4 inclusive, *a* represents a bent magnetized needle, which constitutes one member of the magnetic coupler and revolves about the axis *b*—*b*, see Fig. 3, so that the lower end of the needle describes a circle in a plane at right angles to the axis *b*—*b*.

The upper portion of the needle *a* is concentric with the axis *b*—*b* and has fast on it a small worm *c* or equivalent device, for transmitting continuous rotary motion to a gear *d* which forms part of the time train of the clock *e*, which time train may be such as now commonly employed in clocks. The needle *a* is magnetized by means of a permanent magnet 10, which also serves as a nearly frictionless bearing for the upper end of the needle *a*, by attracting the pointed upper end of said needle against its lower pole face. The needle *a* is maintained in its proper relation to the axis *b*—*b*, by means of a lower offset piece or crank 12, which is loosely mounted on a stationary pin or shaft 13, located in the axis *b*—*b* and supported by the bottom 14 of a casing 15 of non-magnetic material, in which the needle *a* and the gear *d* are located. The casing 15 is provided as shown in Fig. 2, with a partition wall 16, which separates the casing into a lower chamber 17 in which the needle *a* is located and an upper chamber 18 in which the permanent magnet 10 is located, and said wall is provided with an opening for the passage through it of the pointed upper end of the needle to make contact with the permanent magnet 10. The non-magnetic casing 15 is of sufficient size to enable the lower end of the needle *a* to be moved in a circular path.

It may be preferred to employ the permanent magnet 10 so as to inductively magnetize the needle *a*, but it is not desired to limit the invention in this respect, as the needle *a* may be made of hard steel and permanently magnetized, and mounted in suitable bearings to maintain it in the proper relation with respect to the axis of rotation *b*—*b*.

Rotation of the needle *a* is effected by two horseshoe magnets 20, 21, which are mounted upon the pendulum 22 to move therewith. In the present instance the permanent magnets 20, 21, are attached to a bracket 23, which is secured to the pendulum by screws 24 or otherwise, so that the said magnets are in a plane perpendicular to the axis *b*—*b* and in close proximity to the lower end of the needle *a*, and said magnets are arranged with relation to the circular path in which the lower end of the needle *a* is moved, so as to form around a circle alternate magnetic poles marked N. S. N^1 S^1. The lines of force from the magnet poles pass across the four air gaps which are thus formed.

So long as the pendulum is at rest, the pole N of the needle *a* will be attracted by and will point toward one of the south poles S or S^1 of the magnets 20, 21. Assume that the pendulum 22 is at rest and that the needle *a* is attracted by the pole S of magnet 20 as represented in the position of the magnets marked No. 1 in Fig. 4. Also assume that the pendulum is put in motion. Just as soon as the pendulum begins to swing to the right, the N pole of the needle *a* will be deflected in a counter clockwise direction in the effort to continue pointing toward pole S and will be moved into the position No. 2. Very soon, however, the pendulum will reach a position when the repulsion from pole N^1 and the attraction of pole S^1 of magnet 21, will overpower the attraction of pole S and the repulsion of pole N of magnet 20 and the pole N of needle *a*, will continue its counter-clockwise rotation and reach the position No. 3. For any further motion of the pendulum toward the right, the pole N of the needle *a* will continue to point toward the pole S^1, but as the pendulum reverses its motion and begins to swing back again toward the left, the pole N of needle *a* will continue its counter-clockwise rotation, reaching successively the positions Nos. 4 and 5. Further left hand motion of the pendulum will bring about the strong repulsion of pole N of needle *a* by pole N and the attraction by pole S, so that the pole of the needle *a* will take the position No. 6, and as the left hand motion of the pendulum continues, the magnetic forces will continue the contra-clockwise motion of the needle *a* until it reaches the position No. 7 which is 180° from the position No. 3. The pendulum now swings back again toward the right, and the pole N of the needle *a* will continue rotary motion and will pass through the position No. 8 to position No. 1, the point of beginning. It will be observed, that a complete reciprocation or oscillation of the pendulum has brought about a single rotation in a counter clockwise direction of the needle *a*, and it therefore, follows, that for any number of complete reciprocations or oscillations of the pendulum, there will be the same number of rotary turns of the needle in a single direction. By reversing the magnet poles of the needle *a*, the needle *a* would be rotated in the opposite direction, that is, clockwise.

It will thus be seen that the pendulum is not mechanically connected with the time train of the clock but is magnetically coupled therewith, consequently the pendulum or the clock movement can be removed for purposes of shipping, or moving from one place to another, and again placed in position or replaced by a substitute movement by unskilled labor without any danger of injuring or deranging the clock or getting it out of adjustment. In the present instance the pendulum 22 is shown as hung upon a pin 30, see Fig. 1, extended through a leaf spring 31 which is attached to the frame of the clock. By reference to Fig. 1, it will be seen, that the pendulum can be unhooked from the pin 30 and replaced thereon by unskilled hands, and that as there is no mechanical connection between the pendulum and the time train, there can not possibly be any injury done to the working of the clock by handling the pendulum or the clock movement.

The oscillations of the pendulum may be effected in a known manner, by means of current impulses passing through a coil 34 situated in the field of a permanent magnet 35, which forms part of the pendulum.

In the arrangement shown in Figs. 1 to 4, the permanent magnets 20, 21, both move with the pendulum, and while this arrangement may be preferred, it is not desired to limit the invention in this respect, as only one of the magnets may be secured to the pendulum to move therewith, after the manner shown in Fig. 5, wherein the magnet 20 is shown as movable with the pendulum and the magnet 21 is stationary, being secured to the clock casing or other support.

In the arrangement shown in Fig. 5, the magnet 20 is made larger than the magnet 21 and is located at a lower level, so that its poles can pass under the poles of the smaller magnet 21.

The needle *a* has its upper end attracted to the under side of the pole N^1 of the magnet 21, while its lower end is passed through a bracket 36 attached to the pole N^1 of said magnet, and is provided with a crank or arm 37 which constitutes the movable N pole of the needle. The needle *a* is provided with the worm *c* which is designed to engage the gear *d* of the time train. The needle *a* is rotated clockwise as represented in Fig. 6, wherein positions Nos. 1 to 8 of the movable magnet 20 are indicated.

The relation of the poles N, S, of the moving magnet 20 to the poles N^1, S^1 of the fixed magnet 21 is such that when the magnet 20 is in its extreme right hand position No. 3, in Fig. 6, the pole N of the needle *a* will be attracted strongly by the pole S^1 of magnet 21 and will take up the position shown in No. 3.

As the pendulum swings toward the left and reaches the position No. 4, the repulsion of pole N which is nearer the plane of the pole N of the needle *a* than is the pole S^1 of magnet 21, will move the needle slightly in a clockwise direction, and this repelling effect will continue to rotate the needle in the same direction, as the pendulum swings farther toward the left as shown by positions Nos. 5 and 6. Finally a position of the pole N of needle a will be reached, where the combined repulsion of pole N of magnet 20 and the attraction of pole S of said magnet, will completely overpower the attraction of pole S^1 of magnet 21 and will force the pole N of the needle to move into the position No. 7. As the pendulum swings back again toward the right, the pole N of the needle in its effort to follow the pole S, will continue its motion in a clockwise direction, passing successively through positions Nos. 8, 1 and 2, and finally the poles N S of magnet 20 will have moved far enough away from the pole N of the needle, so that the attraction of the pole S^1 of the fixed magnet 21, will exceed the combined attraction of the pole S and the repulsion of the pole N of the movable magnet 20, and the pole N of the needle will be turned into the position No. 3, having now completed one revolution while the pendulum has made one complete reciprocation or oscillation. Obviously this action will be repeated for every complete reciprocation or oscillation of the pendulum, so that the rotations of the needle will measure the reciprocations or oscillations of the pendulum.

In the arrangement shown in Figs. 1 to 4 both magnets 20, 21 are movable with the pendulum, whereas in Figs. 5 and 6, only one magnet as 20 is movable with the pendulum.

In both cases, it will be observed that the magnets 20, 21, coöperate with the magnetized needle to form a magnetic coupler for operatively connecting the oscillating or reciprocating driving member, herein shown as the pendulum 22, with a rotatable member herein shown as the gear d of the time train, and while this feature is especially serviceable for use in clocks, it is not desired to limit the invention in this respect.

It is preferred to inclose the magnetized needle a in a dust-tight casing of non-magnetic material to protect the same from dust and handling and also to inclose the gear d in said casing.

The casing does not interfere with the action of the magnets upon the needle, because the magnetic lines of force pass freely through the walls of the casing. The amount of energy taken from the pendulum to drive the clock movement by means of the magnetic coupler is very slight and is practically constant. It may be preferred to transmit the rotary movement of the needle to the clock movement by a worm and gear, but it is not desired to limit the invention to this particular transmitting means. The needle constitutes a rotatable member of the magnetic coupler and a rotatable armature for the reciprocating or oscillating member of the magnetic coupler, and while it may be preferred to make the rotatable member in the form of a needle, it is not desired to limit the invention in this respect.

Claims:

1. In a pendulum driven clock, in combination, a revoluble member connected with the gear train of the clock and carrying a magnetic pole outside of its axis of revolution, magnets coöperating with said revoluble member and one of which is mounted upon the pendulum of the clock to induce motion of complete rotation in said revoluble member by reciprocation of the permanent magnetic field across the axis of rotation of said pole.

2. In a clock, in combination, a time train, a pendulum mechanically disconnected from said time train, means for oscillating said pendulum, and means for magnetically coupling said pendulum with said time train to drive the latter by said oscillating pendulum.

3. In a clock, in combination, a time train, an oscillating pendulum for driving said time train mechanically disconnected therefrom, and means comprising mechanically disconnected members for directly transforming the oscillations of said pendulum into motion of continuous rotation in the time train, one of said members being connected with said pendulum and the other with the said time train.

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

HENRY E. WARREN.

Witnesses:
JAS. H. CHURCHILL,
J. MURPHY.