

July 29, 1924.

C. L. BEARD

1,502 840

ELECTRIC CLOCK

Filed Sept. 30, 1921

2 Sheets-Sheet 1

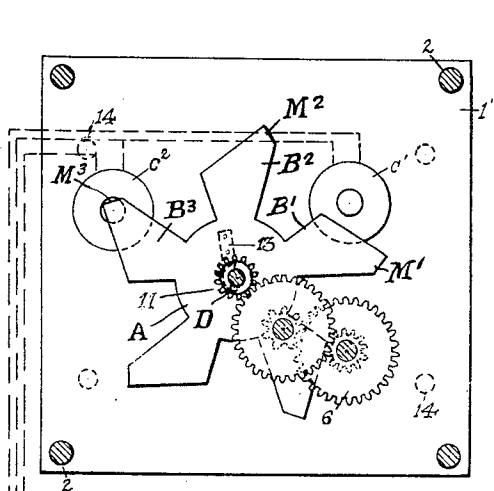


Fig. 1.

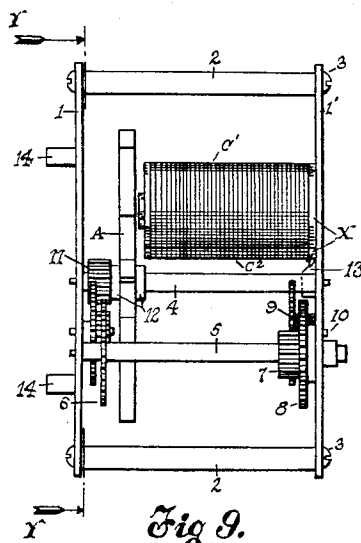


Fig. 9.

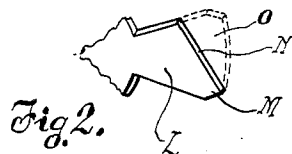
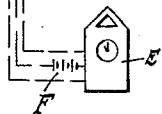


Fig. 2.

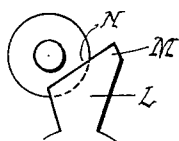


Fig. 3.

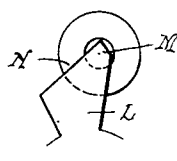


Fig. 4.

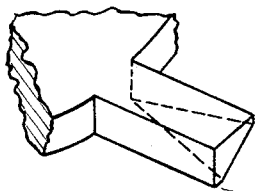


Fig. 5.

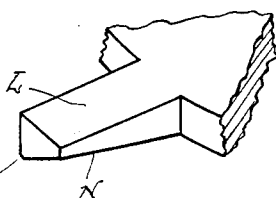


Fig. 6.

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2 Sheets-Sheet 2

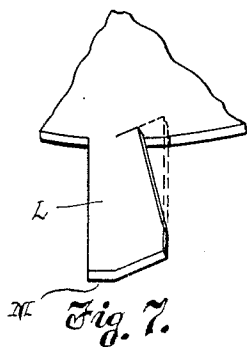


Fig. 7.

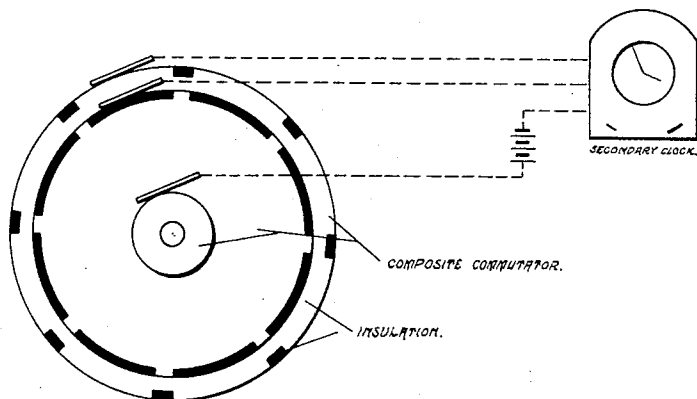


Fig. 8.

Charles L. Beard, Inventor.

Patented July 29, 1924.

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# UNITED STATES PATENT OFFICE.

CHARLES L. BEARD, OF CHESTER, PENNSYLVANIA.

## ELECTRIC CLOCK.

Application filed September 30, 1921. Serial No. 504,398.

*To all whom it may concern:*

Be it known that I, CHARLES L. BEARD, a citizen of the United States, residing at Chester, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Electric Clocks, of which the following is a specification.

This invention relates to time measuring devices and more particularly to that type of device known as secondary clocks which are designed to be controlled in their operation by a master clock. Such clocks or secondary devices are commonly used in manufacturing plants, hotels, theatres, stations, ships, &c., in fact wherever in a plurality clock system the time is held uniform with and by an accurate master clock.

A main object of my invention is to provide a simple and effective electrically operated mechanism for actuating such devices and by so doing avoid the wear to which clocks using pawls, escapements, ratchets, and other mechanical means are subject.

A further object of my invention is to provide a device of the character described, the operation of which is ensured regardless of the position in which the clock is required to be installed or placed. The installations of secondary clock systems on ships in particular have been unsatisfactory due to the extreme ranges of movement to which the ships are subjected in a high sea, thus causing at times the failure of types of clocks employing escapements, mercury balances, and other mechanical means under such conditions. Excessive vibration, jars, etc., have interfered with such secondary devices in some applications and one of the objects of my invention is to provide a structure which will function when installed in any position.

A further object of my invention is to provide a secondary device which is silent, obviating therein, by the particular construction and means hereinafter described, all noise which so commonly attends the movement or shifting of the hands or indicating members of devices employing mechanical means, such as ratchets, pawls, and escapements. Such noises are decidedly objectionable under some conditions where the installations of clocks are called for.

In large time systems it has become com-

mon practice to operate electrically, so called secondary clocks in identical time registry with a master clock the operation being obtained by circuit making and breaking means connected with the master clock and controlling circuits to the operating mechanism of the secondary clocks. My invention provides a simple, effective and silent electrically operated secondary clock for such systems and one in which the actuating member is operated by magnets and without the necessity of mechanical escapements, ratchets, and pawls thereby ensuring the function of the device in any place or position of operation which is found to be necessary.

In the accompanying drawings:

Fig. 1 is a view showing in main part the actuating armature and magnets and their relative positions.

Fig. 2 is a detailed view of one of the pole pieces of the armature.

Fig. 3 and Fig. 4 are views showing magnets and pole pieces disengaged and in operative engagement respectively.

Figs. 5, 6, and 7 are views showing modified forms of pole pieces.

Fig. 8 is a diagrammatic representation of a commutator and its electrical connections with the master clock.

Fig. 9 is a detail view of the device at right angles to Fig. 1.

Broadly the invention consists of a rotating armature which is actuated by two or more magnets acting alternately on the armature to rotate it in periodic movements, one magnet beginning the movement another magnet completing it. Between the periodic movements the moving parts may be held stationary either by the magnetic action of one of the magnets on the armature or by means of a spring or other drag bearing lightly on one of the moving parts. This spring or drag should when used bear with a pressure only sufficient to hold the moving parts from motions which might result from a displacement or sudden jar to the clock or from other similar causes. This would mean only a slight pressure, the indicating members of the device being counterbalanced, and such as would dissipate but a small part of the effort exercised by the magnets in moving the armature. The magnets may all be electromagnets or one may be a permanent magnet and

the other or others electromagnets. When a permanent magnet is used it will serve to hold the parts stationary between the periodic movements and the electromagnet used in conjunction therewith should be strong enough when energized to move the armature against both the inertia of the moving parts and the influence of the permanent magnet.

10 The operation and the relation of movements of a secondary clock of the character described through a complete cycle and one using only electromagnets is as follows. Each periodic movement begins with the parts in the position shown in Fig. 1 of the drawing. Parts C<sup>1</sup> and C<sup>2</sup> are electromagnets which, in the form of my invention shown, namely a secondary electric clock, are energized through electric connections made by a master clock and by a suitable source of electric current such as a battery. Part A is an armature of substantially disc shape having radial pole pieces integral therewith, the pole pieces being indicated at B<sup>1</sup>, B<sup>2</sup>, B<sup>3</sup>, etc., the number of pole pieces not necessarily being limited. On the spindle D is mounted a gear which meshes with a suitable train of gears for operating the hands of a clock. The magnets C<sup>1</sup> and C<sup>2</sup> are connected by suitable connections to a master clock E in which is a commutator which at intervals of one half minute or other interval makes the following cycle of connections and disconnections viz; first opening of circuit to magnet C<sup>2</sup> and immediately thereafter and, second, the establishing of a circuit through the magnet C<sup>1</sup> and the source of an electric current indicated by F and the holding thereof for the brief interval of time necessary for the magnet C<sup>1</sup> to pull the pole B<sup>1</sup> over so that the tip M<sup>1</sup> is directly over it, third, the breaking of the circuit through the magnet C<sup>1</sup> and the making of a circuit through the magnet C<sup>2</sup> and the source of current F and the holding thereof for the remainder of the minute. Upon the making of the circuit through the magnet C<sup>2</sup> pole B<sup>2</sup> is attracted to magnet C<sup>2</sup> so that the tip M<sup>2</sup> thereof comes to rest over magnet C<sup>2</sup>. At the end of each interval of a minute the tip of a succeeding pole is brought to rest over magnet C<sup>1</sup> for a brief interval of time and then the tip of a pole is swung over to magnet C<sup>2</sup> where it is held for the remainder of the interval. The interval of one minute during which the complete cycle of action takes place is only arbitrary and the interval may be changed to a multiple or a fraction thereof as conditions require. The use of a commutator for making and breaking electrical connections is commonly known to all familiar with the art as is also the use of a master clock for actuating and regulating the same.

This combination of parts and cycle of operations it will be seen allows the use of a simple movement or motion of the primary actuating part A and this simple and limited motion does away with the large number of parts ordinarily employed to translate the proper motion to the registering or indicating parts where the primary actuator has more than one direction of motion such as is found in a reciprocating armature.

The cutting away of the part O of the pole pieces as shown in Fig. 2 results in the swinging of the pole piece through an appreciable angle or arc before it comes to rest over the center of the magnet. This motion results from a variable and increasing force being executed on a pole piece by a magnet as the pole piece advances from the position shown in Fig. 3 to that shown in Fig. 4 or as otherwise expressed the shortening of the path of the magnetic flux from the magnet to the pole piece.

The same effect may be obtained by other forms of pole pieces such as those shown in Figs. 5, 6, and 7.

In some cases where it is not desired to have the circuit energized when not moving the armature a simple spring drag may be included which will bear on any of the moving parts such as A or D and which will exert a pressure just sufficient to keep the moving parts from motion except when one of the magnets actuates the armature.

When one of the magnets is a permanent magnet it is placed in a position corresponding to magnet C<sup>2</sup> in Fig. 1 and the cycle of movement and operation will be as follows:

Magnet C<sup>1</sup> being energized by the source of power through the connection made by the commutator in the master clock and being stronger than the permanent magnet will move the pole piece B<sup>1</sup> in Fig. 1 so that the tip M<sup>1</sup> will come to rest over its center. The electrical connection in the master clock being broken, magnet C<sup>1</sup> will no longer be energized and the permanent magnet in the position of magnet C<sup>2</sup> will move the pole piece B<sup>2</sup> so that its tip M<sup>2</sup> will come to rest over the center of the permanent magnet where it will be held until magnet C<sup>1</sup> is again energized which will be at the end of the minute, or other predetermined interval of time when the same cycle of actions is repeated.

In more specific description of the preferred form my invention and with reference to the drawing, the device consists of a clock frame of conventional construction consisting of plates 1 and 1' and the spacing post 2, the plates being fastened to the post by the screws 3. Suitably associated with the plate 1 are posts or other fastening means which may be utilized in supporting the device. Mounted between

the plates and journaled therein are a plurality of spindles or posts such as 4, 5, 10, etc. The members of the spindles employed being determined by the amount of gearing to be used and may be any number reasonable to the design of the particular clock. In the form of device shown spindle 5 has rigidly mounted thereon adjacent to the plate 1 the gear 6 and also rigidly mounted thereon to rotate therewith, is the pinion 7. The gear 8 is loosely mounted on the spindle and has a hub projection extending through the plate 1' for the mounting of the hour indicating hand and serving as a bearing for the spindle 5 which also projects beyond the plate 1' to form a mounting for the minute hand of the device.

In mesh with the pinion 7 and gear 8 is the combined gear and pinion 9 serving as the reduction medium between the pinion 7 and the gear 8. This combined gear and pinion is mounted on the spindle post 10 supported by the plate 1'. A similar combined gear and pinion is supported by a spindle post on the plate 1 and serves as the compensating medium in gear reduction between the gear 6 and the driving pinion 11. This driving pinion 11 is rigidly mounted on the shaft to rotate therewith adjacent the plate 1.

The armature A is also mounted on this driving shaft 4 to rotate therewith and is held in a predetermined space relation with regard to the plates of the frame by spacing portions or spacing collars 12.

The armature A in the form shown consists substantially of a disc having integral therewith radial poles B<sup>1</sup>, B<sup>2</sup>, etc., which are equally spaced about the perimeter of the armature. Each pole is formed substantially symmetrical with respect to a radius passing through it from the center of the armature A except that one corner is cut away as shown at O in Fig. 2 providing at the outer end of the pole piece a V shaped portion with one side of the V longer than the other.

The cutting away of part of the pole piece at O results in the swinging of the pole piece through an appreciable arc before it comes to rest over the center of the magnet it being the extreme outer or reduced end which centers over the magnet.

Magnets C<sup>1</sup> and C<sup>2</sup> are shown mounted on the plate 1' by screws and with their axes parallel with the axes of the spindles. A suitable insulating disc X is used as a spacer between the magnet and the plate 1'.

In Fig. 1 a spring 13 is shown fastened to plate 1 and bearing on the armature spindle for the purpose of holding the moving parts stationary when not actuated by one of the magnets. This spring may be used for the purpose described either alone or in conjunction with one of the magnets or one

of the magnets may be used alone as an armature pole when in the position shown in Fig. 3 will be held in that position while the magnet is energized. When it is not desirable to employ the magnet for the purpose, the spring drag will hold the parts.

I have shown only a preferred form of my invention and many modifications of the means for holding the moving parts from motion will occur to one skilled in the art, and as a matter of fact, there are many common means for performing this function.

The device described is not only adapted for use in the specific application described, but may be modified for use in other registering devices as will readily occur to one skilled in the art.

Having described my invention in accordance with the requirements of the patent statutes, what I claim as new and desire to secure by Letters Patent is:

1. In mechanism of the class described having a master clock provided with a commutator, a suitable source of electric current and a secondary measuring device energized by said source and through said commutator, in combination in said secondary measuring device, a pair of electro-magnets adapted to be alternately energized and a rotating armature having a plurality of poles, said combination being characterized by the following cycle of operations: first, the moving of an armature pole by one of said magnets into a position to be exerted upon by a maximum force by said magnet; second, the holding of said position for an interval of time; third, the moving away of said pole from such position by the other magnet, and simultaneously with said third operation, the moving of another pole into a position to be exerted upon by the first of said magnets with a force less than the maximum, said simultaneous operation being caused by the action of the second magnet moving an armature pole from a position in which said second magnet exerts a force on said latter pole to a position in which it exerts a maximum force upon it; fourth, the moving of the second said pole by the first said magnet into a position of maximum force thereon, from which point said magnets continue to act upon said armature poles in the manner of the above cycle.

2. In a secondary electric clock, in combination, an armature having radial pole pieces, a pair of electromagnets associated with the armature and adapted to alternately attract said pole pieces as alternate impulses pass through said magnets.

3. A secondary electric clock comprising a frame, a chain of gears within said frame, a rotatable armature within said frame, and adapted to actuate said chain of gears, said armature having an odd number of radial poles, a pair of electromagnets and means

whereby said magnets are alternatively energized to alternately attract and actuate successive pole pieces.

4. In a secondary electric clock, in combination, an armature having an odd number of pole pieces, a pair of electro-magnets associated with said armature and each adapted to actuate its successive pole piece as successive impulses pass through said magnets.

10 5. An electric clock mechanism having a master clock and a secondary clock, the latter comprising a rotatable armature having radial pole pieces, two electro-magnets adapted to be alternately energized by said master clock whereby alternate pole pieces  
15 are successively attracted and actuated.

6. In a secondary electric clock, in combination, an armature having radial pole pieces, a pair of electro-magnets associated  
20 with the armature and adapted alternately

to attract said pole pieces successively as alternate impulses pass through the electro-magnets.

7. In a secondary electric clock, in combination, an armature having radial pole pieces, a pair of electro-magnets associated with the armature and adapted alternately to attract said pole pieces successively as alternate impulses pass through the electro-magnets, the ends of said pole pieces being  
25 V shaped with one side of the V shorter than the other and having the magnets so arranged with respect thereto that when the point of the V of one of the teeth is centered over one of the magnets the point of the V  
30 of another of the teeth is laterally displaced from the center of the magnet nearest it.

In testimony whereof I affix my signature.  
CHARLES L. BEARD.