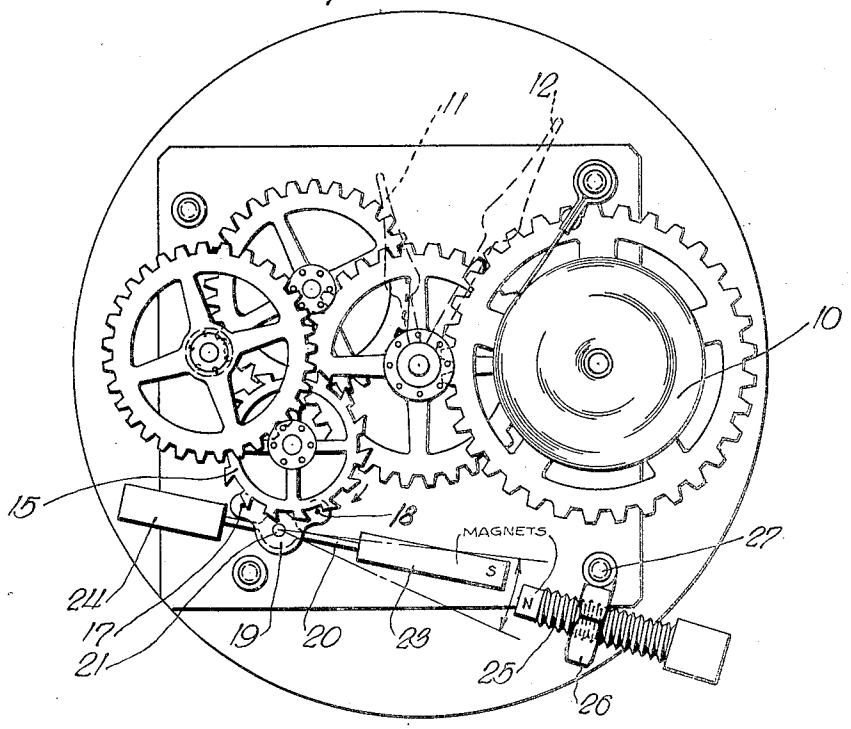
Nov. 17, 1936. E. O. SCHWEITZER, JR 2,061,047

TIMEPIECE

Filed Dec. 17, 1932

Fig. 1.



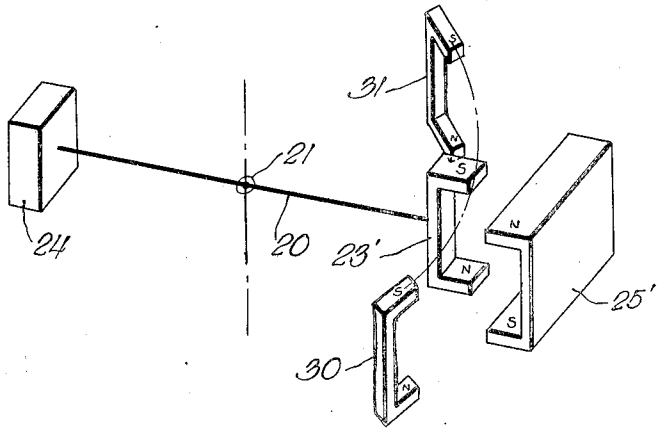


Fig. 2.

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TIMEPIECE

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11 Claims. (Cl. 58—117)

The present invention relates to timepieces, and more particularly to the means for controlling the escapement of mechanical timepieces such as clocks, watches chronometers, or other time controlled movements.

It is an object of the present invention to provide an escapement control which shall be independent of gravity, whereby the control may be mounted in any position, and which shall be inexpensive and not require the delicate balancing required of the usual type of hair spring controlled balance wheel.

Timepieces of various kinds employing a mechanical mechanism also have some form of oscillator controlling the rate at which a spring or weight actuator is permitted to release its energy. This oscillator may take the form of a pendulum or a balance wheel and hair spring. Pendulums, to be accurate, require a fixed position of the timepiece. Balance wheels require a delicate construction with a delicate spring to store energy for the return movement. The balance wheel must be balanced so that its period of oscillation is not altered by change of position. Balance wheels are expensive and delicate and depend for their operation on a spring which is easily damaged. The spring is affected by external magnetic influences and also by temperature.

It is an object of this invention to improve very substantially the operation of such time mechanisms, and I do this first by the improvement of the oscillator, since it is this member that is most likely to become deranged and subject to error.

I have replaced the pendulum which has the objections above enumerated by a mechanism which can be used in watches, clocks, or the like and which is not subject to the necessity for a fixed position, is not subject to expansion and contraction to alter its effect, and which is not subject to wear and tear due to motion of the clock parts. I accomplish this improvement by using an escapement control which comprises a small permanent magnet which acts on a similar magnet mounted on the spindle on which the pendulum is usually mounted. This constitutes, in effect, the replacement of the usual bob on a pendulum by a permanent magnet, and the replacement of gravity by a second permanent magnet. The stationary magnet can be adjusted toward and away from the oscillating magnet to change the rate of oscillation of the oscillating magnet and thereby regulate the action of the timepiece.

I have found that my magnetic oscillator will permit the operation of the timepiece in any position and that the change of strength of magnetism can be made practically insensitive to temperature changes or to changes with time.

My present invention is particularly adapted for use on automobiles or in places subject to vibration or shock such as would derange the symmetry of the usual hair spring, or affect the clock on account of the vibration of the hair spring of the balance wheel. It is well known that clocks or watches used on the panel of automobiles fail to keep time of even the roughest accuracy. My present invention provides a much needed improvement in clocks that are intended for such use.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is a view of a clock gear train, showing the escapement and my improved control means therefor; and

Figure 2 is a fragmentary isometric view illustrating a modification of my invention.

In Figure 1 I have shown my invention applied to a clock mechanism of a standard construction wherein a clock spring 10 furnishes the driving power for driving the clock hands 11 and 12 through the usual gear train under the control of an escapement wheel 15. The escapement is controlled by pallets or pins 17 and 18 on an oscillating member 19 in the usual manner, well known in the art. My present invention is concerned with the means for controlling the oscillation of the member 19 to control the timing of the clock. In the prior practice it has been customary to control the member 19 by means of a pendulum, in the case of clocks, or by a balance wheel and hair spring, in the case of watches or of wall clocks not provided with a pendulum. Pendulums, or balance wheels and hair springs, are subject to the objections previously noted. In accordance with my invention I eliminate the gravity controlled pendulum as well as the balance wheel and hair spring. This is accomplished in the following manner: The oscillating member 19 is controlled by another oscillating member which corresponds to a pendulum but is not gravity controlled. This other oscillating member comprises a rod 20 secured to a spindle 21 that carries the oscillator 19. The rod 20 is provided with a permanent magnet 23 at one end and a counterweight 24 at its other end. The permanent magnet and the counterweight are so arranged that the

center of gravity of the oscillating system comprising the rod 20 with its magnet and its counterweight is exactly at the center of the spindle 21. The permanent magnet 23 oscillates through a small arc in the field of another permanent magnet 25. The adjacent faces of the magnets 23 and 25 are of opposite polarity. The magnet 25 is screw threaded and is mounted upon a brass nut 26 that is secured to one of the uprights 27 of the frame supporting the clockwork. The magnet 25 may be adjusted toward and away from the magnet 23 to alter the force of attraction between the magnets 23—25 and thus alter the natural period of oscillation of the oscillating rod 20. It may be seen that what I have done in the present case is to replace the ordinary pendulum bob by a permanent magnet and have replaced gravity by a second permanent magnet. In view of this I am able to counterbalance the oscillator to make it independent of gravity whereby the clock may be mounted in any desired position.

Within the operating angle of magnet 23 the restoring force of the magnetic field between the stationary magnet 25 and the movable magnet 23 exerts a restoring force upon the magnet 23 and its connected system tending at all times to move the magnet towards its central or neutral position. This restoring force increases as displacement increases, and the ratio of the restoring force to displacement does not decrease as displacement increases, but either remains constant or preferably increases as in the case of a gravity pendulum.

It is apparent that the permanent magnet 25 need not be located nor mounted in the manner indicated. The permanent magnet 25 may be located anywhere adjacent the permanent magnet 23 so as to place the permanent magnet 23 in the field of the magnet 25. By moving the permanent magnet 25 closer to or farther from the magnet 23 the natural period of oscillation of the rod 20 is varied. This is fundamentally different from the manner of regulating a pendulum clock wherein the bob is moved toward or away from the center of oscillation to vary the natural period of the pendulum. In effect, I vary the gravitational force rather than the length of the pendulum.

In Figure 2 I have shown a modified form of magnetic control. The magnet 23' corresponds to the magnet 23 of Figure 1 and is of a generally channel or C-shape. The magnet 25' corresponds to the magnet 25 of Figure 1 and is also of a generally C or channel-shape. The poles of the magnets 23' and 25' are of the polarities indicated in the drawing so that the upper poles of the two magnets are of opposite polarity and the lower poles of the two magnets are of opposite polarity, whereby the magnet 25' always attracts the magnet 23'. It is to be noted that the magnet 25' is of a substantially greater length than the magnet 23' so that the field of this magnet is substantially constant throughout the range of oscillation of the magnet 23'. On each side of the magnet 23', and within the proximity of the extreme limits of oscillation of the magnet 23', I have placed two permanent magnets 30 and 31. When the magnet 23' oscillates in one direction the shoes thereof move adjacent the upper and lower shoes of the permanent magnet 30, and when the magnet 23' oscillates in the opposite direction the shoes thereof move adjacent the upper and lower shoes of the permanent magnet 31. The upper pole shoes of the magnets 30 and 31 are of the same polarity as the upper pole shoe of the magnet 23', and the lower pole shoes of the magnet 30 and 31 are of the same polarity as that of the lower pole shoe of the magnet 23'. Thus the magnets 30 and 31 repel the magnet 23', whereas the magnet 25' attracts the magnet 23'. The force of repulsion of the magnets 30 and 31 increases as the arc of oscillation of the member 20 increases so that the greater the arc of oscillation the greater will be the accelerating force of the magnet 23' as it starts moving from either extreme position. By this arrangement a greater arc of travel, results in a higher speed of travel so that the periodicity of the member 20 remains substantially constant regardless of the length of swing, within the limits of motion of the oscillating member. By this arrangement a variation of the tension of the spring 10, as the clock runs down, does not affect the accuracy of the time piece. The magnet 25' may be adjusted toward and away from the magnet 23' in any desired manner in order to adjust the natural period of oscillation of the member 20. Likewise, the magnets 30 and 31 may, if desired, be mounted so as to permit their adjustment.

While I have herein spoken of an adjustment of the magnetic field by varying the position of the permanent magnet 25 or 25', as the case may be, the equivalent result may be obtained by moving a variable magnetic shunt into and out of the region of the permanent magnet 25 or 25' and thereby vary the effect of the field of that magnet with respect to the oscillating permanent magnet.

If desired, the permanent magnet 25' may be entirely omitted, relying exclusively upon the magnets 30 and 31. In such case it is essential that means be provided for adjusting the fields of the magnets 30 and 31 in order to regulate the action of the time piece. This varying effect can be produced by bringing those magnets closer together or farther apart, or by moving a variable shunt into the region of the field produced by those magnets.

While I have herein shown my invention applied to a clock it is equally applicable to other time controlled mechanism employing an escapement.

In compliance with the requirements of the patent statutes I have herein shown and described a few preferred embodiments of my invention. It is however to be understood that the invention is not to be limited to the precise arrangement shown, the same being merely illustrative. What I consider new and desire to secure by Letters Patent is:

1. An escapement including an oscillating member, a permanent magnet mounted thereon, and means establishing a magnetic field in the path of movement of the magnet for controlling the rate of oscillation of the member, said last means including a pair of permanent magnets, one each of said pair of magnets being located adjacent each of the opposite extreme positions of oscillation of the first magnet and arranged with poles of like polarity in position to react with a like pole of the first magnet.

2. An escapement including an oscillating member, a permanent magnet mounted thereon, and means establishing a magnetic field in the path of movement of the magnet for controlling the rate of oscillation of the member, said last means including a stationary permanent magnet adjacent the first magnet in its mid position, and

a pair of permanent magnets, one each of said pair of magnets being located adjacent each of the opposite extreme positions of oscillation of the first magnet and arranged with poles of like polarity in position to react with a like pole of the first magnet.

3. An escapement including a permanent magnet, and permanent magnets between which said first named magnet oscillates, said permanent magnets being arranged with poles of like polarity in position to react with a like pole of the first mentioned magnet, whereby the second mentioned magnets repel the first mentioned magnet to a mid position with forces that increase as the amplitude of swing of the first magnet increases.

4. An escapement of the type including an oscillating member maintained in oscillation by periodically received impulses and having means biasing it to a position substantially midway between its extreme positions during oscillation, and wherein the biasing means accelerates the member as it moves towards its biased position, said member being moved past its biased position by its own inertia and decelerated by the biasing means as it moves past its biased position, characterized in that the biasing means comprises a permanent magnet forming a part of the oscillating system, and other permanent magnet means coacting therewith, said last named magnet means comprising a magnet for attracting the magnet of the oscillating system and other magnets for repelling the magnet of the oscillating system.

5. An escapement of the type including an oscillating member maintained in oscillation by periodically received impulses and having means biasing it to a neutral position substantially midway between its extreme positions during oscillation, and wherein the biasing means accelerates the member as it moves towards its neutral position, said member being moved past its neutral position by its own inertia and decelerated by the biasing means as it moves past its neutral position, characterized in that the biasing means comprises a permanent magnet forming a part of the oscillating system, and other permanent magnet means coacting therewith, said other magnet means comprising a pair of magnets one each being located closer to at least one extreme position reached by the oscillating member than to the mid position of the oscillating member and being arranged with poles of like polarity in position to react with a like pole of the first mentioned magnet and, whereby the force of bias urging the member to its mid position increases as the amplitude of oscillation of the member increases.

6. An escapement including a rotating member, an oscillating member controlling the rotating member, a supporting member mounted on and conjointly oscillating with said oscillating member, a magnet carried by said supporting member and movable in an arcuate path upon oscillation thereof, a counterweight carried by said supporting member, said magnet and counterweight being so arranged with respect to said supporting member that the center of gravity of the oscillating system will be located at substantially the point of connection of said supporting member with said oscillating member, and means establishing a magnetic field in the path of movement of said magnet for controlling the rate of oscillation of said oscillating member, said last named means imposing a restoring torque on said oscillating member which increases with increases in amplitude of oscillation of said oscillating member at a ratio not less than a predetermined value.

7. An escapement including a rotating member, an oscillating pendulum member controlling the rotating member and comprising a rod pivoted intermediate its ends, a magnet carried by one end of said rod, a counterweight on the other end of said rod, said magnet and counterweight being arranged with respect to the ends of said rod whereby the center of gravity of the oscillating system will be located substantially at the pivot point of said rod, and means establishing a magnetic field in the path of movement of said magnet for controlling the rate of oscillation of said oscillating member which magnetic field provides a force for restoring the magnet from a displaced position towards neutral position, which force increases with the displacement, the ratio of restoring force to displacement remaining constant or increasing with increase in displacement.

8. An escapement comprising a rotating member and an oscillating member controlling rotation of said rotating member, a magnet on said oscillating member, magnetic means disposed adjacent the arcuate path of movement of said magnet on said oscillating member for controlling the rate of oscillation thereof, said magnetic means being so arranged with respect to said oscillating member as to provide a restoring force on said member increasing with increases in the displacement of said oscillating member the restoring force increasing at least as fast as displacement as displacement proceeds.

9. An escapement comprising a rotating member and a magnetic pendulum pivotally mounted to control the rotation of said rotating member, and magnetic means disposed adjacent the arc of movement of said pendulum and coacting to produce a restoring force on said pendulum which increases with increases in the displacement of said pendulum for controlling its rate of oscillation the restoring force increasing at least as rapidly as displacement as displacement proceeds.

10. An escapement comprising a rotating member and a pivoted magnetically controlled pendulum having a magnet fixed at one end thereof, and fixed magnetic means for producing oscillation of said pendulum disposed adjacent the arc of movement of said pendulum magnet, the fixed magnetic means and the magnet on the pendulum cooperating to provide a restoring force acting upon the pendulum which force increases with the displacement of the pendulum from central position at no less than a predetermined rate.

11. An escapement comprising a rotating member and a pendulum having escapement means controlling the rate of rotation of said member in accordance with the rate of oscillation of said pendulum, a magnet carried by said pendulum, and magnetic means mechanically free of said pendulum and disposed adjacent the path of movement of said pendulum for controlling the amplitude and frequency of oscillation of said pendulum, the fixed magnetic means and the magnet on the pendulum cooperating to provide a restoring force acting upon the pendulum which force increases with the displacement of the pendulum from central position at no less than a predetermined rate.

EDMUND O. SCHWEITZER, JR.