Sept. 30, 1924. 1,509,899

D. W. MANN

STOP WATCH MECHANISM

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Fig. 1.

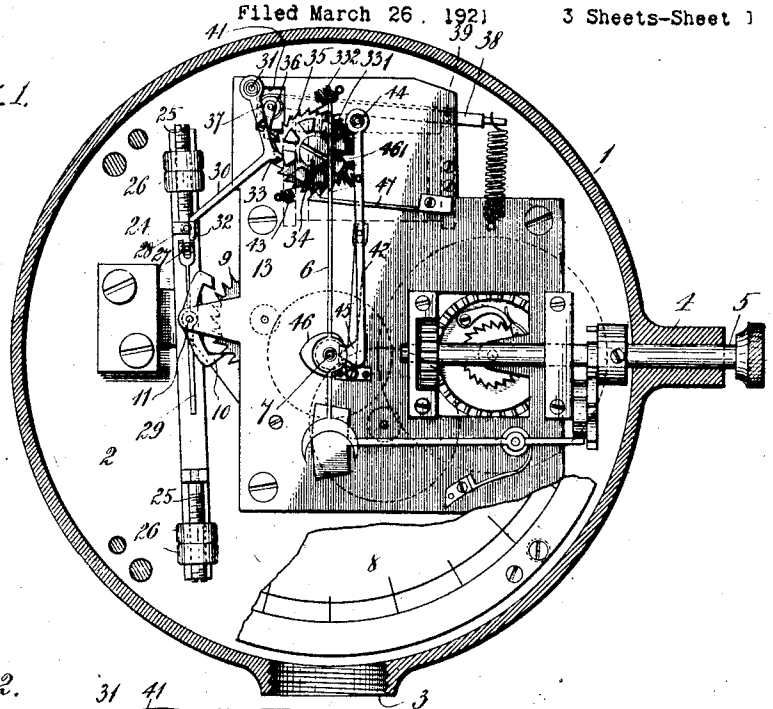
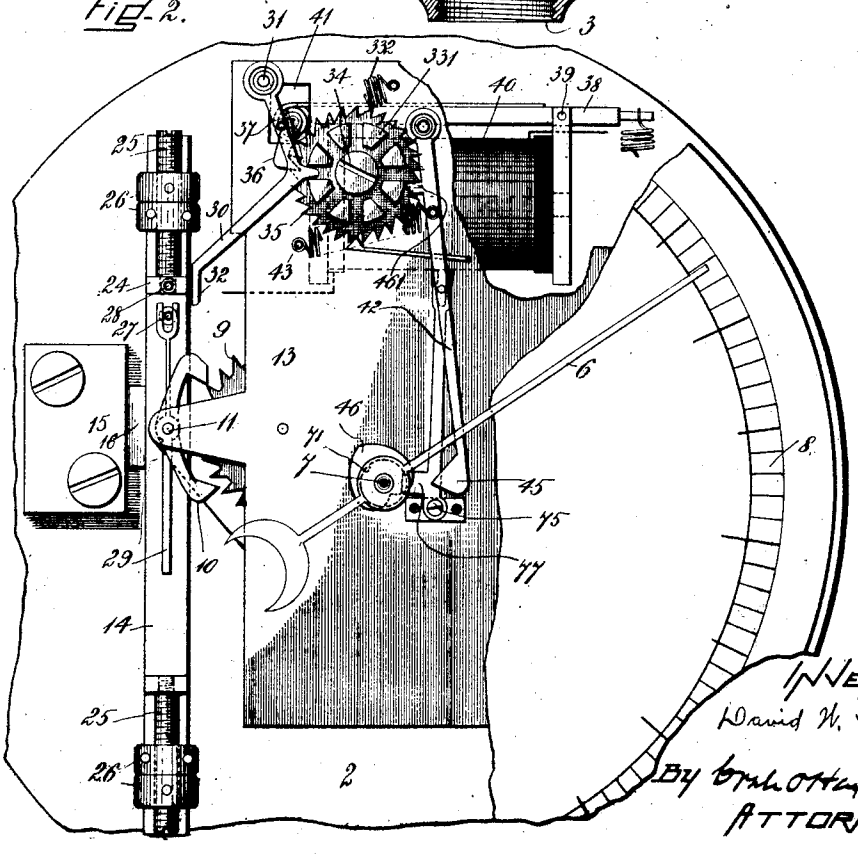


Fig. 2.



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D. W. MANN

STOP WATCH MECHANISM

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Fig. 3.

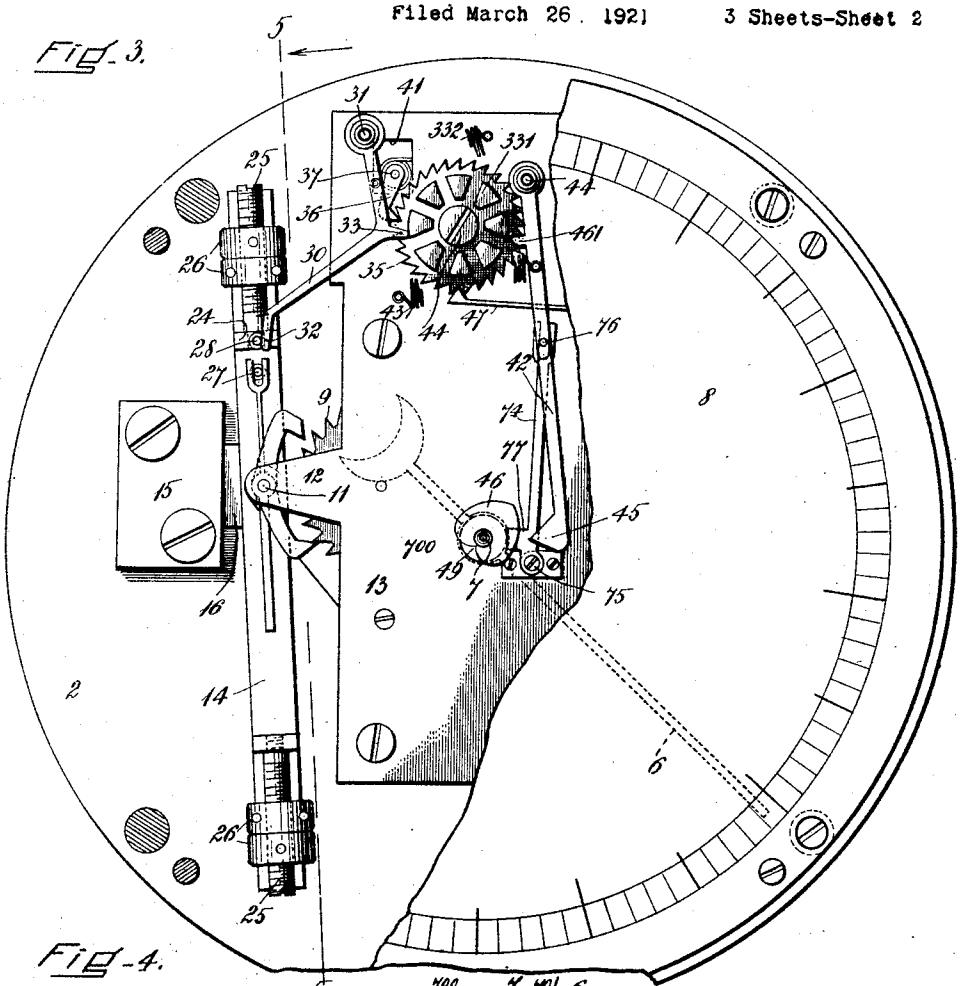
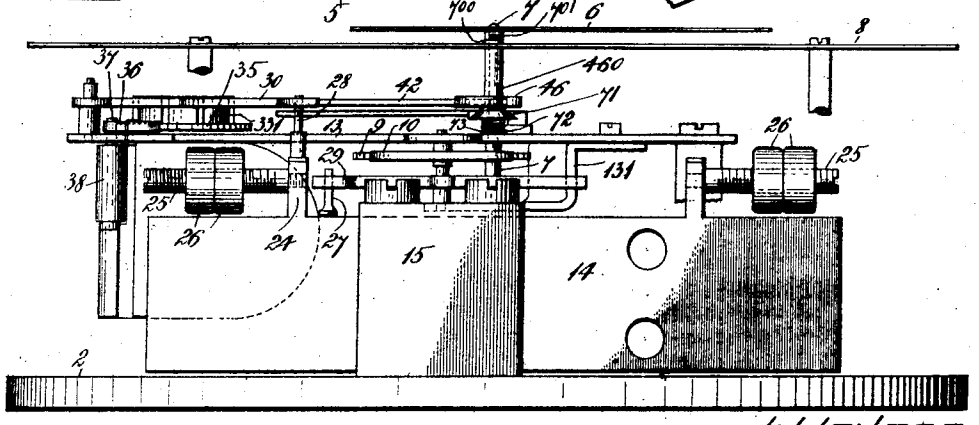



Fig. 4.

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STOP WATCH MECHANISM

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Fig. 5.

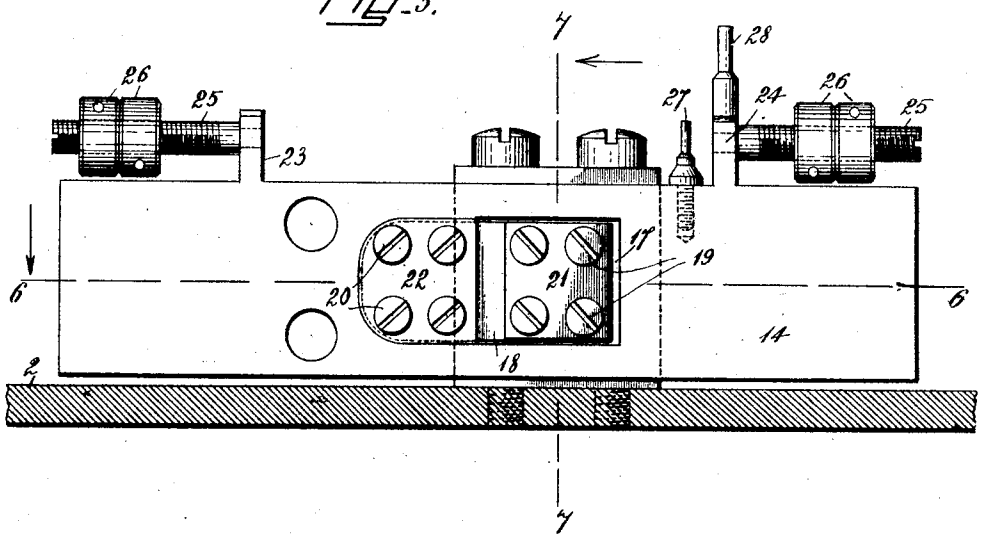



Fig. 6.

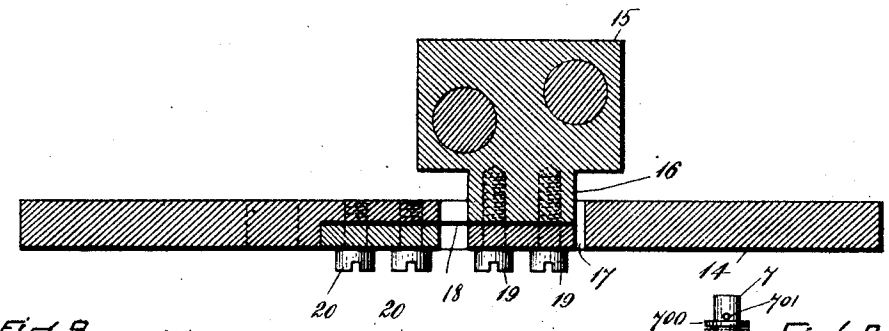



Fig. 9.

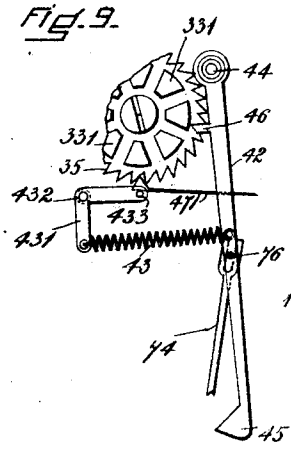



Fig. 7.

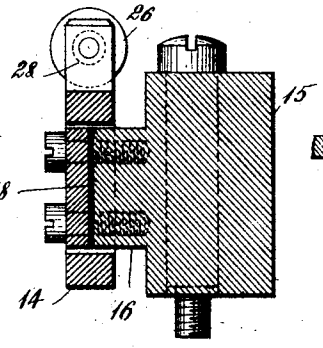
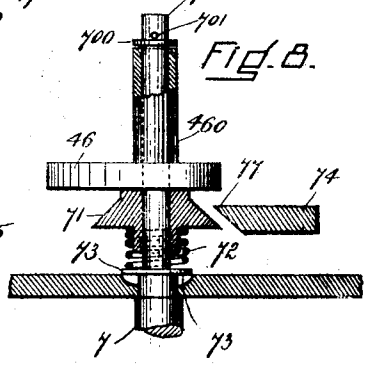



Fig. 8.

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Patented Sept. 30, 1924. 1,509,899

# UNITED STATES PATENT OFFICE.

DAVID W. MANN, OF LINCOLN, MASSACHUSETTS.

## STOP-WATCH MECHANISM.

Application filed March 26, 1921. Serial No. 455,805.

*To all whom it may concern:*

Be it known that I, DAVID W. MANN, of Lincoln, in the county of Middlesex and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Stop-Watch Mechanism, of which the following is a specification.

My invention is an improvement in mechanism useful in stop watches or the like, and relates more particularly to the escapement. In watches of ordinary construction the escapement is controlled by the oscillation of a balance wheel governed by a flat spiral spring called usually the hair-spring. The second hand of a watch, therefore, moves over its dial by small jumps whose period is that of an oscillation in one direction of a balance wheel, which usually occupies one fifth of a second, and the watch can only be stopped at such intervals. Any attempt to increase this rate of vibration above five per second and so increase the accuracy of the stop watch in timing is rendered difficult, if not almost impossible, because of the friction of pivots, etc.

The purpose of my invention is to make an escapement which is adapted particularly for use where it is desired to measure short intervals of time with more accuracy than is possible by means of an ordinary stop watch, and for this purpose I provide a vibratory member which is suitably connected with the escapement and is of such character that rates of vibration of 24 per second or even higher have been secured.

My invention will be understood by reference to the drawings in which it is shown in its preferred form, together with a portion of the usual works of a watch or clock showing how my embodiment is connected thereto so as to control the watch movement. These parts being of usual construction are not described except so far as may be necessary to explain my invention. In the drawings the parts are very much enlarged.

Figure 1 is a front view of a stop watch movement embodying my invention showing the mechanism at rest, a portion of the face being broken away.

Fig. 2 is a similar view, enlarged, showing the mechanism in operative position.

Fig. 3 is a similar view showing a portion of the mechanism after it has been stopped, but before it has been reset or brought to the position shown in Fig. 1.

Fig. 4 is a side view taken from the left side of Fig. 3.

Fig. 5 is a section on line 5—5 of Fig. 3 showing the vibratory member in plan.

Figs. 6 and 7 are sections on lines 6—6 and 7—7, respectively, of Fig. 5.

Fig. 8 is an enlarged sectional detail illustrating the hand-setting mechanism.

Fig. 9 is a modification of the hand-setting control.

1 is a cylindrical case comprising base plate 2 and having a threaded opening 3. 4 is a neck through which projects the usual winding arbor 5. 6 is the second or measuring hand mounted in the usual way on a central arbor 7 to be moved over the clock face 8 and to be returned to a zero mark. The clock face may be divided into units of any desired character. The arbor 7 carrying the hand is rotated by mechanism well known to clock makers, and hence need not be described. Such mechanism comprises the usual spring which is wound by means of the arbor 5 and the usual mechanism operated thereby.

9 is the escapement wheel of usual form operated from the main spring in the usual way. 10 is the escapement lever by which the escapement wheel is alternately released and stopped so that it allows a step-by-step movement to be imparted to the hand 6. The escapement lever 10 is mounted on an axis 11, the upper bearing for which is part of the top face plate 13. The lower end of the axis 11 sets into a hanger 131 in the form of an arm attached to the under side of plate 13. The base 2 has attached to it a block 15 having a neck 16. The vibratory member 14, which takes the place of the ordinary pendulum mechanism, consists of a plate having a rectangular opening 17 of sufficient width to receive the neck 16, which projects through it. The vibratory member 14 is attached to the neck 16 by means of a leaf-spring 18 one end of which is attached to the clock by means of a plate 21 and screws 19, while the other end of the spring is attached to the vibratory member by a plate 22 and screws 20, this arrangement being such that the vibratory member is supported from the spring at its centre of gravity.

The vibratory member 14 carries two supports 23, 24 from each of which projects a screw 25 carrying threaded weights 26 by which the timing of the member 14 may be

adjusted. It also carries two pins 27 and 28, the pin 28 being preferably mounted on support 24. One of these pins 27 engages the notched end of a spring impulse lever 29, which is mounted on the axis 11 so that it and the escapement lever 10 will move together.

It is desirable for accurate timing that the impulse lever should be a spring because it permits varying amplitudes of the vibratory member above the minimum angle required to unlock the escapement and so permits the vibratory member to take up its natural period of vibration without substantial restraint from the escapement.

The lever 29 lies parallel with the vibratory member, acting as the operative connection between the escapement lever 10 and the vibratory member 14. The pin 28 which is mounted on the support 24 forms one member of a stop mechanism the other member of which is a lever 30 pivoted at 31 on top of the plate 13. This lever 30 is of angular shape and has a toe 32 at its end to engage the pin 28 and a heel 33 which when the mechanism is at rest engages one of a series of projections 331 on the upper surface of a ratchet wheel 35, mounted on an arbor 34 in the plate 13. The ratchet is operated by a pawl 36. The pawl 36 is mounted on the end of a pin 37 carried by an armature 38 pivoted at 39 to a suitable frame and operated by means of an electromagnet 40. The plate 13 is slotted as at 41 to allow the mechanism which operates the pawl 36 to be moved by the armature to do its work. Thus when the electromagnet is energized the ratchet 35 will be moved one tooth. The projections 331 are mounted about the face of the ratchet to form slots or recesses, these slots registering with every third tooth of the ratchet so that at each third movement of the ratchet by the pawl 36 the heel 33 of the lever 30 will be pulled into the registering slot by the spring 332 one end of which is attached to the lever 30 and the other to the plate 13. Normally the heel 33 rests against the edge of one of the projections at which time the toe 32 engages the pin 28 and holds the vibratory member stationary.

Figure 1 shows the mechanism at rest and Fig. 2 shows these parts in operative position, the vibratory member being actuated through the escapement. When the parts are in the position shown in Fig. 1 the vibratory member is held against motion by means of the contact between the toe 32 and the pin 28. In Fig. 2 where the electromagnet has been energized and has caused the pawl to turn the ratchet one tooth and the heel has been pulled into the slot between two of the projections 331 by means of its controlling spring 332, the toe of the lever 30 has been moved away from the pin 28 so that the vibratory member is free to vibrate. At the next movement of the ratchet by the pawl 36 one of the projections 331 pushes under the heel of the lever 30 so that the heel rests upon it as in Fig. 3.

The projections 331 on the ratchet 35 serve also to operate the hand-setting lever 42. This lever is pivoted at 44 and is controlled by a spring 43 which tends to pull its outer pointed end 45 against the heart-shaped cam 46 on the arbor 7 carrying the hand 6, the cam 46 and the hand being arranged in predetermined position and held together preferably as described below so that when the parts are in the position shown in Fig. 1 the hand points to zero. It will be seen from Fig. 2 that the hand has been moved away from zero and the setting member has been carried with it. The stopping of the clock is due to the second impulse of the electromagnet by which the ratchet is again pushed one tooth and the lever 30 rides again against the projection 331 on the ratchet, thus bringing the toe 32 of the lever 30 into engagement again with the pin 28.

The lever 42 is operated in the same way. It has a finger 461 which its spring 43 holds against the periphery of the projections 331 on the ratchet and the first movement of the pawl which sets the parts in operation by moving the ratchet, throws the finger 461 on the lever 42 out from its normal position between two of the projections 331 onto the top of one of these projections. There the lever sets as shown in Figs. 2 and 3 while the clock is in operation and until after the movement of the ratchet which stops the clock. The energizing of the electromagnet for a third time causes the ratchet to turn so that the finger 461 falls again between the projections on the ratchet and the end 45 of the lever 42 strikes the heart-shaped member 46 and moves it until the point of the lever 42 falls into the recess 49 in the setting member at which time the hand will point to zero. 47 is a spring pawl to restrain the movement of the ratchet.

I prefer to provide means now to be described for causing the cam 46 and the hand 6 to rotate with the arbor without slipping when the watch is in use. For this purpose I have provided mechanism which will be understood from Fig. 8. The hand 6 is mounted on a sleeve 460 on the shaft 7 and under a washer 700 held in place on the shaft by a pin 701. The setting cam 46 is also mounted on the sleeve 460 in the usual way. Instead of the light spring usually employed in devices of this sort for causing the sleeve carrying the hand to rotate with the shaft, a clutch 71 is provided which is held in contact with the sleeve 460 by a spring 72 which by pressing at its lower

extremity on a washer 73 pushes the clutch 71 against the sleeve 460 with sufficient pressure as to cause it to rotate with the shaft 7 without slipping.

To reset the hand when the clock is stopped a lever 74 is pivoted at 75 on the plate 13. One end is forked to ride over the pin 76 on the under side of lever 42. The lever 74 carries a wedge piece 77 shaped to engage a corresponding wedge or conical surface on the upper side of the clutch 71, this arrangement being such that as the setting lever 42 is moved into engagement with the setting member or cam 46, the wedge piece 77 is moved into engagement with the clutch 71 and depresses it against the spring 72 so as to release the setting member and hand, thus allowing the setting member and the sleeve 461 carrying the hand 6, which comes in contact with it, to move together when struck by the end of the lever 42.

While the arrangement of the spring 43 is for controlling the lever 42, under ordinary circumstances I prefer the construction shown in Fig. 9 where the spring 43 connects the lever 42 with one arm of a bell crank lever 431 pivoted at 432 on the plate 13. The bell crank has a pin 433 at the end of its other arm which engages the holding pawl 471 which differs from the holding pawl 47 in the other views by being mounted on a very thin piece of metal of sufficient strength only to support it. In Fig. 1, etc., it will be seen that the effort required of the electromagnet in starting the clock is greater than that required in stopping it or in setting it back to the zero point, this condition being caused by the fact that more power is required to lift the projection 461 on lever 42 from between the projections 331 on ratchet wheel 35 than is required when the projection 461 rides on the projections 331. From Fig. 9 it will be seen that these differences in effort are equalized by the varying pressure of pin 433 against the pawl 471, these differences in pressure being caused by the action of the spring 43 against the end of the bell crank lever 431.

The operation of the device will be understood it is believed from the above description. In the circuit of the electromagnet is a circuit closer adapted to close the circuit momentarily to attract the armature and operate the ratchet 35. Upon the position of the ratchet 35 depends the operation of the stop watch. Energizing the electromagnet 40 attracts its armature 38 which causes the pawl 36 to move the ratchet 35 one tooth. If the parts are in their normal stopped position as shown in Fig. 1 an electrical impulse in the electromagnet causes the pawl 36 to move its ratchet 35 one tooth which brings one of the slots between the projections 331 in register with the heel 33 of the lever 30 so that the heel will be drawn into the slots by the spring 332 thus separating the toe 32 and the pin 28, and allowing the escapement to operate the vibrator. This situation continues until the next impulse is given to the armature to move the ratchet another tooth which causes the heel 33 of the lever 30 to be pushed out of the slot so that it rests against one edge of the next projection and its toe is pushed against the pin 28 and stops the movement of the vibrator and the watch. The next impulse of the armature pushes the ratchet another tooth so that it passes in contact with the heel 33 until the parts come again into the position shown in Fig. 1 ready to have this cycle of operation repeated.

During this time the projections on the other side of the ratchet are performing similar operations in connection with hand-setting mechanism. The finger 461 on the lever 42 in this case normally lies in one of the slots between the projections 331. At the first movement of the ratchet the finger 461 is thrown out of the slot and rests against an adjacent projection during the movement of the ratchet. At the third movement of the ratchet the lever 42 is reset and is in position to reset the hand 6 to zero because of its bearing on the heart-shaped member 45. The lever 42 also operates the hand clutch 71 as above described at the same time. The novelty of its construction and operation is due mainly to the construction and operation of the vibratory member which, because of the spring connection between the vibratory member and its support, does away with pivots and other devices which might produce friction, and thus allows an increase in the rate of vibration of the vibratory member which permits of very accurate measurement of short intervals of time.

I prefer to use a flat or leaf spring as part of the mounting for the vibratory member as it lends itself particularly well to the purpose. Other embodiments of my invention will occur to those skilled in the art.

What I claim as my invention is:—

1. In an escapement mechanism, a stationary member, a spring mounted thereon, a vibratory member mounted between its ends on said spring, an escapement lever, and means connecting said escapement lever and said vibratory member whereby said vibratory member will be vibrated.

2. In an escapement mechanism, a stationary member, a spring mounted thereon, a vibratory member mounted on said spring, a flexible escapement lever, and means connecting said flexible escapement lever and said vibratory member whereby said vibratory member will be vibrated.

3. In an escapement mechanism, a stationary member, a spring mounted thereon, a vibratory member mounted at its centre of

gravity on said spring, an escapement lever, and means connecting said escapement lever and said vibratory member whereby said vibratory member will be vibrated.

4. In an escapement mechanism, a vibratory member and means for supporting it comprising a spring attached to said vibratory member at its centre of gravity, and a stationary member, said spring being attached to said stationary member, an escapement lever and connections between said escapement lever and said vibratory member whereby said vibratory member will be vibrated.

5. In an escapement mechanism, a stationary member, a leaf spring mounted thereon, a vibratory member mounted between its ends on said leaf spring, and means for operating said vibratory member.

6. In an escapement mechanism, a stationary member, a leaf spring mounted thereon, a vibratory member mounted between its ends on said leaf spring, and means for operating said vibratory member, said vibratory member being provided with adjustable means whereby the timing of its vibrations may be adjusted.

7. In an escapement mechanism, a stationary member, a leaf spring mounted thereon, a vibratory member mounted on said leaf spring, and means for operating said vibratory member, in combination with a stop mechanism comprising a spring-controlled lever, normally restraining said vibratory member from movement, and means for disengaging said stop lever from said vibratory member, said stop lever having a projection and said last-named means comprising a ratchet having separated projections, each adapted to engage the projection on said lever, and means for turning said ratchet, whereby the projection on said stop lever will be allowed to be moved under the stress of said spring between the projections on said ratchet.

8. In an escapement mechanism, a stationary member, a leaf spring mounted thereon, a vibratory member mounted on said leaf spring, and means for operating said vibratory member, in combination with a stop mechanism comprising a spring-controlled lever normally restraining said vibratory member from movement, and means for disengaging said stop lever from said vibratory member, said disengaging means comprising an electromagnet, a wheel adapted to be operated thereby and bearing projections on its face, said spring-controlled lever being shaped to move between said projections or against them according to the relative location of said projections and said lever.

DAVID W. MANN.