March 6, 1951 F. J. MULHERN 2,544,346

TIMING DEVICE

Filed Oct. 17, 1946 2 Sheets-Sheet 1

Fig. 1.

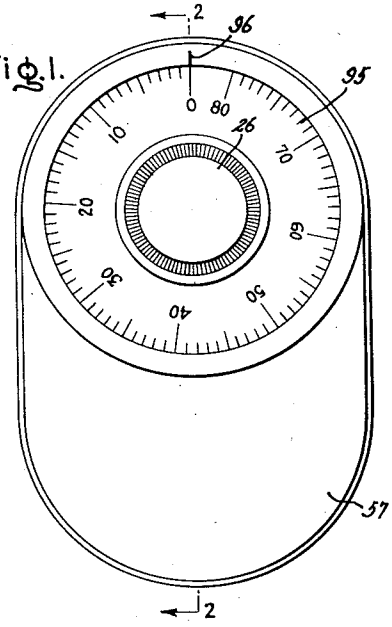


Fig. 2.

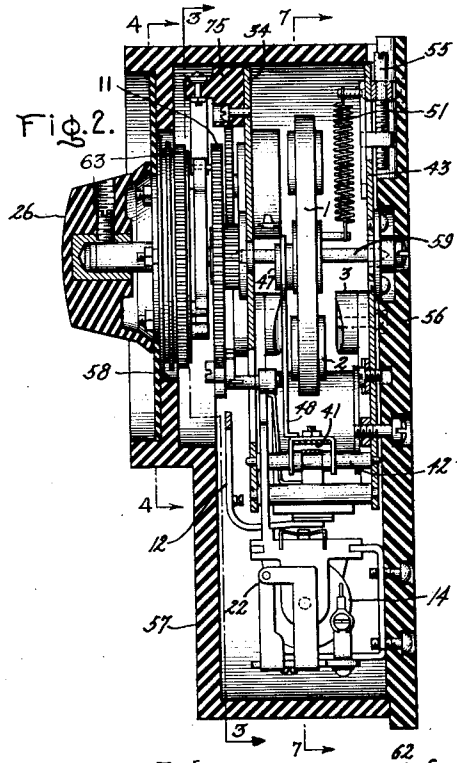


Fig. 3.

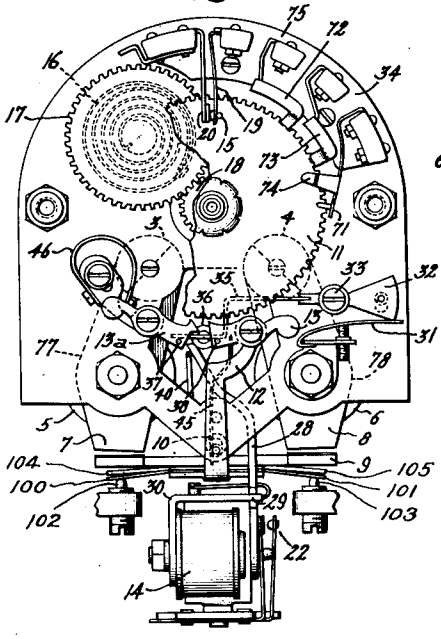


Fig. 4.

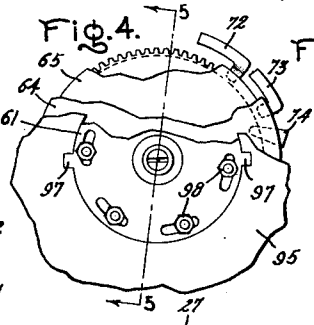


Fig. 5.

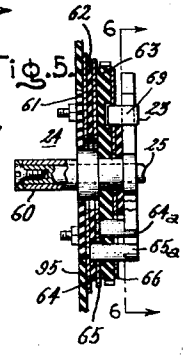
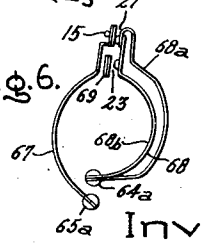


Fig. 6.



Inventor:
Frederick J. Mulhern,
by Chauncey H. Mott
His Attorney.

March 6, 1951 F. J. MULHERN 2,544,346

TIMING DEVICE

Filed Oct. 17, 1946 2 Sheets-Sheet 2

Fig. 7.

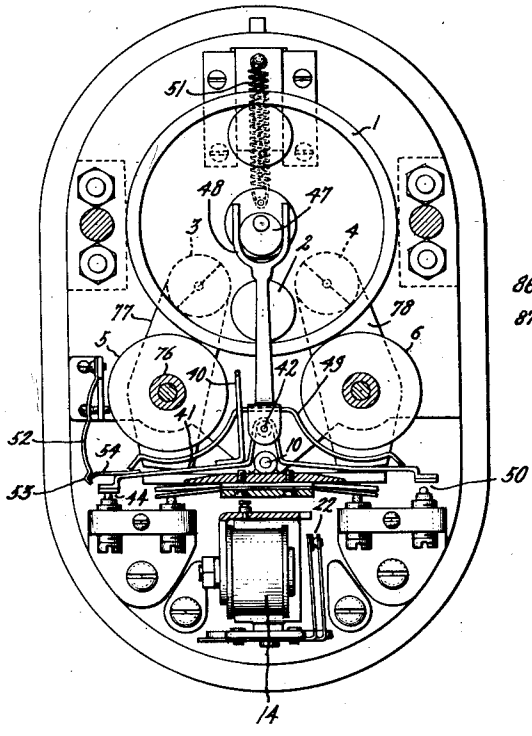
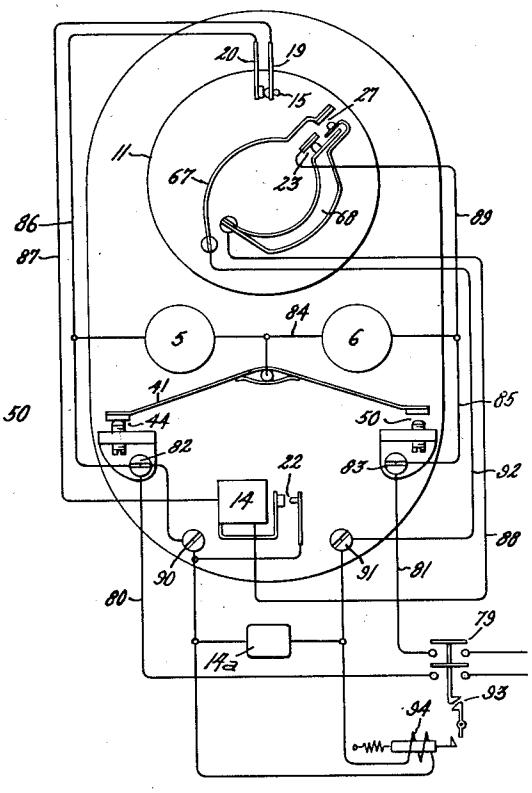


Fig. 8.



Inventor:
Frederick J. Mulhern,
by Claude H. Mott
His Attorney.

Patented Mar. 6, 1951

2,544,346

UNITED STATES PATENT OFFICE

2,544,346

TIMING DEVICE

Frederick J. Mulhern, Troy, N. Y.

Application October 17, 1946, Serial No. 703,901

7 Claims. (Cl. 161—1)

1

My invention relates to timing devices, more particularly to electrically operated direct current timing devices, and has for its object a reliable and inexpensive precision device for measuring time intervals with great accuracy.

My invention is especially useful in devices for performing an operation after a predetermined time interval, such as the operation of a switch, although it is applicable to other time devices, such as clocks.

For a more complete understanding of my invention, reference should be had to the accompanying drawings, Fig. 1 of which is a front elevation view of a timing device embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1, looking in the direction of the arrows; Fig. 3 is a fragmentary front elevation view of a portion of the mechanism taken along the line 3—3 of Fig. 2; Fig. 4 is a fragmentary view of the time adjustment device showing the contact rings; Fig. 5 is a sectional view taken along the line 5—5 of Fig. 4, looking in the direction of the arrows; Fig. 6 is a fragmentary view showing the time operated control switches; Fig. 7 is a sectional view taken along the line 7—7 of Fig. 2, looking in the direction of the arrows, while Fig. 8 is a diagram showing the electric connections.

Referring to the drawings, in carrying out my invention in one form I provide a timing element comprising a balance wheel 1 carrying a disk-shaped armature 2 adjacent its periphery which is attracted alterantely by pairs 3 and 4 of stationary magnet poles so as to cause the wheel to oscillate back and forth in a predetermined arc and thereby constitute a timing element. The oscillatory movement of the wheel 1 controls the alternate energization of the coils 5 and 6 having respectively the pairs of poles 3 and 4, the poles of each pair being on opposite sides of the wheel so that the armature 2 moves between them. Also, the magnet coils are provided with lower pairs of poles 7 and 8, respectively, which effect an oscillatory movement of an armature 9 having a central pivot 10 whereby a timing ratchet wheel 11 is advanced clockwise in substantial synchronism with the balance wheel, one tooth for each oscillation of the armature 9. As shown, an arm 12 has its lower end secured to the armature 9 at a point just below the pivot 10 and extends upward to a point adjacent the periphery of the wheel 11 where it is provided with a ratchet pawl 13 arranged to engage the teeth on the periphery of the ratchet wheel 11. When the ratchet wheel 11 has been

2

turned through a predetermined angle corresponding to the time interval for which the device is set, the pawl-driving means for the ratchet wheel is moved by a starting magnet coil 14 to release the ratchet wheel which is thereupon returned to a starting position by a biasing spring and, concurrently therewith, a circuit is closed to initiate a desired control operation or, for example, sound an alarm 14a (Fig. 8).

These control operations by the ratchet wheel 11 are carried out by means of a pin 15 secured to the ratchet wheel adjacent its periphery and extending parallel with the axis of the ratchet wheel. At the beginning of the timing operation the pin 15 is in the biased position indicated in Fig. 3, to which position it is moved by counterclockwise rotation of the ratchet wheel 11 by means of a spiral spring 16. The spring 16 is connected to a gear 17 so as to give a clockwise rotation to it and this gear in turn meshes with a gear 18 secured to the ratchet wheel 11. In this position of the pin 15 it engages a flexible contact arm 19 and bends it toward the left, as seen in Fig. 3, against a rigid contact arm 20, which contact arm forms a stop for the pin 15 and the ratchet wheel 11. The two contact arms 19 and 20 are in an energizing circuit for the starting coil 14 so that this coil can be energized to start the timing operation.

As the ratchet wheel 11 is turned clockwise, the pin 15 disengages the contact arm 19 which in turn disengages the contact arm 20 but the starting coil circuit is maintained closed through a switch 22 which is operated by the armature of the starting coil 14 so as to be closed when the coil is energized, the switch 22 being connected in parallel with the contacts 19 and 20. Also in circuit with the starting coil 14 is a biased closed switch 23 mounted on an adjustable time setting disk member 24 (Fig. 5). In order to set the device for a desired time interval, this member 24 is adjusted on its shaft 25 by means of a knob 26 (Figs. 1 and 2), whereby the position of the switch 23 is adjusted with respect to the starting position of the pin 15. In other words, the time interval is adjusted by varying the angular distance over which the pin 15 has to travel in order to open the switch 23 and stop the timing operation. Substantially simultaneously with the opening of the switch 23 the pin 15 closes a switch 27 to operate the control device, such as the bell 14a (Fig. 8).

The primary purpose of the starting magnet 14 is to effect the engagement of the pawls 13 and 13a with the ratchet wheel 11 at the begin-

ning of the timing operation, and their disengagement with the ratchet wheel at the end of the timing operation so that the wheel 11 can be turned counterclockwise by the spring 16 back to its starting position shown in Fig. 3. As shown in Fig. 3, when the magnet 14 is deenergized its armature 28 is pulled through a small angle in a counterclockwise direction about its pivot at the point 29 on the magnet core member 30 by means of a spring 31. The spring 31 bears on a lever 32 mounted on a pivot 33 on a supporting plate 34. On the left-hand end of the lever 32 is a strap member 35 which is bent downward and carries secured to it a cylindrical bearing member 36 biased by the spring 31 into engagement with the rounded upper end of the armature 28. Also, the strap 35 engages two pins 37 and 38 on the ends respectively of the pawls 13 and 13*a* whereby the pawls are held by the spring 31 with their adjacent ends in a lowermost position out of engagement with the teeth of the ratchet wheel. Also, when in this position the upper end of the armature 28 engages an arm 40, the lower end of which is secured about a contact arm 41 (Fig. 7) mounted on a pivot pin 42. The pin 42 is pivotally secured to the supporting plates 34 and 43 (Fig. 2). The armature thus moves the arm 40 toward the left, as seen in Fig. 7, whereby the left-hand end of the contact arm 41 is held in engagement with a stationary contact 44.

When the magnet 14 is energized at the beginning of the timing operation its armature 28 is moved clockwise about the pivot 29 whereby the upper end of the armature moves under the cylindrical member 36 and thereby raises it and likewise raises the strap member 35 against the force of the spring 31 whereby the pawls 13 and 13*a* are moved by their biasing springs, such as the springs 45 and 46, about suitable intermediate pivots so that their adjacent ends move upward into engagement with the ratchet wheel. Oscillation of the arm 12 and the pawl 13 by the armature 9 now turns the ratchet wheel step by step.

For the purpose of controlling the alternate energization of the magnet coils 5 and 6, the balance wheel 1 has secured to its shaft an eccentric 47 (Figs. 2 and 7), cooperating with which is the forked upper end of an arm 48 the lower end of which is pivoted on the pivot pin 42 and has secured to it a spring 49, the opposite ends of which engage the ends of the contact arm 41. Therefore, as the balance wheel oscillates, the arm 48 is rocked back and forth thereby to move the contact arm 41 into engagement with first one and then the other of the stationary contacts 44 and 50 whereby the coils 5 and 6 are controlled.

By means of a helical biasing spring 51 having one end secured to the balance wheel 1, the balance wheel is biased to the angular position shown in Figs. 2 and 7. In this position the armature is in an intermediate position between the pairs 3 and 4 of magnet poles and, likewise, the arm 48 is held by the eccentric in an intermediate position.

A snap action is provided for the switch arm 41 by means of a spring arm 52, the movable end of which is provided with a bearing 53 engaged by the end of a leaf spring 54 secured to the contact arm. Snap action is obtained by reason of the fact that the right-hand end of the spring 54 at the point of attachment to the arm 41 is below a line joining the bearing 53 and the axis of the pivot 42 when the arm 41 engages the contact 44. This provides a downward force on the left-hand end of the contact arm. On the other hand, this point of attachment is above the line joining 42 and 53 when the arm 41 engages the contact 50. This construction, it will be observed, gives an over-center spring biasing and snap acting force to the contact arm 41.

As shown clearly in the drawings, the various parts are mounted on the two supporting plates 34 and 43 which are suitably secured together in parallel spaced relation with each other, these plates being made of non-magnetic material such as brass as is also the balance wheel. A screw 55 is provided by means of which the tension of the spring 51 may be adjusted. The two supporting plates and the mechanism mounted thereon are in turn mounted on a supporting base 56 made of electrically insulating material, and a front cover 57 is provided which fits on the base and is provided with an aperture 58 through which extends the knob 26 and the pivoted time-setting disk means 24.

The shaft 25 of the time setting means is secured to the supporting plate 34 in alignment with the shaft 59 of the balance wheel 1. The mechanism 24 which forms an adjustable support for the switches 23 and 27 consists of a bushing 60 which is rotatably mounted on the shaft 25 and on which, in turn, are mounted three disks 61, 62 and 63 made of electrically insulating material and to which are secured three electric contact rings 64, 65 and 66, the rings being electrically insulated from each other and from the bushing 60. Two electrically conducting posts 64*a* and 65*a* secured respectively to the rings 64 and 65 form electric connections between the rings and the spring contact arms 67 and 68 of the switches 23 and 27 and also serve as supports for the contact arms. A contact 69 of the switch 23 is secured to the contact ring 66. The electrically insulating disk 63 is provided with teeth on its periphery with which engages a spring pawl 71 (Fig. 3) whereby the time-setting means 24 is secured in its adjusted position.

It will be understood from the drawing (Fig. 6) that the pin 15 in moving toward the right first engages the upper end of the contact arm 67 and moves it into engagement with the upper end of the branch 68*a* of the contact arm 68, the engaging parts of which constitute the switch 27. A slight continued movement of the pin 15 moves the contact arm 68*a* toward the right so that its bent-over upper end engages the upper end of the contact arm part 68*b* and moves it toward the right thereby disengaging it from the contact 69, as shown in Fig. 6, and effecting the opening of the switch 23. The two parts 68*a* and 68*b* of the contact arm 68 are electrically connected together at their lower ends which are secured to the post 64*a*.

As shown in Figs. 3 and 4, spring contact arms, or brushes, 72, 73 and 74, are provided in position to respectively frictionally engage the contact rings 65, 64 and 66. These spring contact arms 72, 73 and 74 are mounted on a support 75 made of electrically insulating material secured in turn to the supporting plate 34. The contact arms 19 and 20 are likewise secured on the support 75. As shown in Fig. 3, the stop pawl 71 is mounted on an extension of the contact arm 74.

It will be observed that each of the magnet coils 5 and 6 has two magnetic operating circuits. The coil 5, for example, is provided with a central magnetic core 76 (Fig. 7) the ends of which are secured to strap core members 77 and 78 (Figs.

7 and 3) made of magnet core iron at opposite ends of the coil 5. These two core members 77 and 78 are secured to the inner adjacent surfaces of the supporting plates 34 and 43. The two lower ends of the core members are formed with the two magnet poles 7, while the two upper ends are provided with disk-shaped members forming the poles 3. It will be understood that the coil 6 and its magnet core members have substantially the same construction as just described in connection with the coil 5. The reluctance of the magnetic circuits for the two lower pairs of poles 7 and 8 is sufficiently high to provide for the required flux across the upper pairs of poles 3 and 4 after the armature 9 has moved to its attracted position.

Referring to Fig. 8, the timing apparatus is started by closing a suitable normally open push button switch 79 whereby a suitable source of electrical supply is connected to the conductors 80 and 81 connected to the binding posts 82 and 83 which are electrically connected to the contacts 44 and 50. Since the contact member 41 is in engagement with the contact 44, as previously described, a circuit is closed for the coil 6 leading from the post 82 through the contact arm 41, conductor 84, coil 6, and conductor 85 to the binding post 83. Also, a circuit is closed for the coil 14 leading from binding post 82 through conductor 86, the switch formed by contact arms 19 and 20, conductor 87, coil 14, conductor 88, switch 23 and conductor 89 to the binding post 83. The coil 14 immediately picks up its armature 28 whereby the switch 22 is closed to by-pass the contacts 19 and 20, and the ratchet members 13 and 13a are moved into engagement with the ratchet wheel 11.

The coil 6 pulls the wheel 1 in a counterclockwise direction and, in doing so, cam 47 moves the contact arm 41 to disengage the contact 44 and engage the contact 50 whereby the coil 6 is deenergized and the coil 5 energized for oscillation in a clockwise direction. When the pin 15 has been moved far enough to engage the contact arm 67 and close the switch 27, the device 14a is energized, this marking the end of the time interval for which the device is adjusted.

The circuit for the device 14a leads from the binding post 82 to the binding post 90, through the device 14a to the binding post 91, and then through conductor 92, the switch 27, the contact arm 68, the switch 23 and the conductor 89 to the binding post 83. Immediately thereafter, upon a slight continued movement of the pin 15, the switch 23 is opened, whereby the device 14a and the coil 14 are deenergized. The timing device thereupon resets itself in the position indicated in the drawing ready for the next timing operation. As shown, the push button switch 79 is held closed by a latch 93 which is actuated by a coil 94, connected across the device 14a, whereby the switch 79 is opened when the device 14a is deenergized. This electromagnetic trip 93, 94, as changed by amendment to this application, in itself forms no part of my invention.

Adjustment of the time-setting device 24 is facilitated by a dial 95 secured to the time-setting device and cooperating with a fixed mark 96. As shown, the dial 95 is provided with a central aperture into which fits the insulating disk 61, the dial being secured against rotation with respect to the disk by means of projections 97 on the disk which fit in notches in the dial. The dial is secured in place by means of the

knob 26 which, in turn, is secured to the sleeve 60, as shown in Fig. 2. Adjustment of the dial relative to the sleeve 60 can be effected by loosening clamping bolts 98 which secure the disk 61 in place whereby the disk and the dial can be adjusted angularly relative to the sleeve 60. As shown, elongated apertures are provided in the disk 61 for the bolts 98.

The reason for always starting the time device by energization of the coil 6 is to assure that the device starts with an impulse of predetermined duration. This will be clear from the fact that the leaf springs 100 and 101 secured to the armature 9, and which engage respectively electrically insulated adjustable stops 102 and 103, position the armature 9 in a starting position as shown in Figs 3 and 7 when the coils 5 and 6 are deenergized and the pawl 13 released from the ratchet wheel 11. Therefore, as seen in Fig. 3, when the coil 6 is energized the pawl, which has been released by energization of the coil 14, drops into a notch between the teeth and is moved first toward the left-hand and then upon the energization of the coil 5 back toward the right-hand to pickup another tooth.

It should be noted, furthermore, that for accuracy in timing, the stop 103 preferably is adjusted upward against the spring 101 so as to provide an assisting force for the armature 9 to overcome the force of the spring 16 opposing movement of the ratchet wheel 11. It will be noted that stronger leaf springs 104 and 105 are provided respectively behind the springs 100 and 101.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A time device comprising a balance wheel, a first armature mounted on said balance wheel, a timer wheel, a second armature mounted for movement from one position to another, a driving connection between said second armature and said timer wheel for turning said timer wheel step by step upon movement of said second armature between said positions, electromagnetic means cooperating with said armatures so as to move each of said armatures between two positions, switching means operated by said balance wheel as it oscillates for controlling the energization of said electromagnetic means to produce oscillation of said balance wheel and step by step movement of said timer wheel, and switching means actuated by said timer wheel when said timer wheel has been turned to a predetermined angular position.

2. A time device comprising a balance wheel, a first armature mounted on said balance wheel, two electromagnets, means mounting said electromagnets in spaced relation with each other and each with at least one pole adjacent said balance wheel, switching means operated by said balance wheel as it oscillates for alternate energization of said electromagnets so as to attract said first armature thereby to cause said balance wheel to oscillate, a time wheel, a second armature for said electromagnets operated from one position to another by the energization of said electromagnets, and a driving connection between said second armature and said time wheel for turning

said time wheel step by step upon said alternate energization of said electromagnets.

3. A time device comprising a balance wheel, a first armature mounted on said balance wheel, two electromagnets, means mounting said electromagnets in spaced relation with each other and each with at least one pole adjacent said balance wheel, switching means operated by said balance wheel as it oscillates for alternate energization of said electromagnets so as to attract said first armature thereby to cause said balance wheel to oscillate, a time wheel, a second armature for said electromagnets operated from one position to another by the energization of said electromagnets, a driving connection between said second armature and said time wheel for turning said time wheel step by step upon said alternate energization of said electromagnets, and switching means actuated by said time wheel when said time wheel has been turned to a predetermined angular position.

4. A time device comprising a balance wheel, a first armature mounted on said balance wheel, two electromagnets, means mounting said electromagnets in spaced relation with each other and each with at least one pole adjacent said balance wheel, switching means operated by said balance wheel as it oscillates for alternate energization of said electromagnets so as to attract said first armature thereby to cause said balance wheel to oscillate, a timer wheel, a second armature for said electromagnets operated from one position to another by the energization of said electromagnets, a driving connection between said second armature and said timer wheel for turning said timer wheel step by step upon said alternate energization of said electromagnets, a biased closed second switching means in circuit with said electromagnets, and operating means for said second switching means carried by said timer wheel for effecting the opening of said second switching means when said timer wheel has been turned to a predetermined position thereby to deenergize said electromagnets.

5. A time device comprising a balance wheel, a first armature mounted on said balance wheel, two electromagnets each provided with two pairs of poles, means mounting said electromagnets in spaced relation with each other and each with one pair of poles on opposite sides of said balance wheel, switching means operated by said balance wheel as it oscillates for alternate energization of said electromagnets so as to attract said first armature thereby to cause said balance wheel to oscillate, a timer wheel, a second armature cooperating with the other two pairs of poles of said electromagnets so as to be operated from one position to another by the energization of said electromagnets, a driving connection between said second armature and said timer wheel for turning said timer wheel step by step upon said alternate energization of said electromagnets, means for disabling said driving connection, a third electromagnet provided with an armature connected to operate said disabling means, a second switching means for said third electromagnet, and operating means carried by said timer wheel for operating said second switching means when said timer wheel is turned to a predetermined position thereby to disable said driving connection.

6. A time device comprising a balance wheel, a first armature mounted on said balance wheel, a pivotally mounted time member, means biasing said time member to a predetermined angular strating position, a second armature mounted for movement from one position to another, a driving connection for turning said time member step by step upon movement of said second armature between said positions, electromagnetic means cooperating with said armatures so as to move each of said armatures between two positions, a second electromagnetic means provided with a third movable armature biased to an unattracted position, a connection between said third armature and said driving connection for disabling said connection when said third armature is moved to its unattracted position, switching means in circuit with said second electromagnetic means, means carried by said time member for operating said switching means to energize said second electromagnetic means when said time member is returned to its starting position in accordance with its bias, and switching means operated by said balance wheel as it oscillates for controlling the energization of said first electromagnetic means to produce oscillation of said balance wheel and step by step movement of said time member.

7. A time device comprising a balance wheel, a first armature mounted on said balance wheel adjacent its periphery, two electromagnets each provided with two pairs of poles, means mounting said electromagnets in spaced relation with each other and each with one pair of poles on opposite sides of said wheel, a second armature cooperating with the two other pairs of said poles, switching means operated by said balance wheel as it oscillates for alternately energizing said electromagnets so as to attract said first armature thereby to cause said wheel to oscillate, a ratchet wheel, means biasing said ratchet wheel to a predetermined starting position, pawl means operated by said second armature for advancing said ratchet wheel, a third electromagnet provided with a third movable armature biased to an unattracted position, a connection between said third armature and said pawl means for moving said pawl means so as to release said ratchet wheel when said third armature is moved to its unattracted position, a biased closed time switch in circuit with said third electromagnet, means mounting said switch for angular adjustment about the axis of said ratchet wheel thereby to introduce a predetermined time interval, operating means on said ratchet wheel for opening said time switch to deenergize said third electromagnet when said ratchet wheel has been turned to a predetermined angular position with respect to said switch whereupon said ratchet wheel is released and turns back to said starting position in accordance with its bias.

FREDERICK J. MULHERN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,970,412	Bates	Aug. 14, 1934
2,163,419	Warren	June 20, 1939
2,388,686	Habig	Nov. 13, 1945

FOREIGN PATENTS

Number	Country	Date
504,553	Great Britain	Apr. 27, 1939
551,877	Great Britain	Mar. 12, 1943