

June 19, 1934.

A. J. KERCHER

1,963,495

TIMING DEVICE

Filed April 15, 1931

5 Sheets-Sheet 2

FIG. 3.

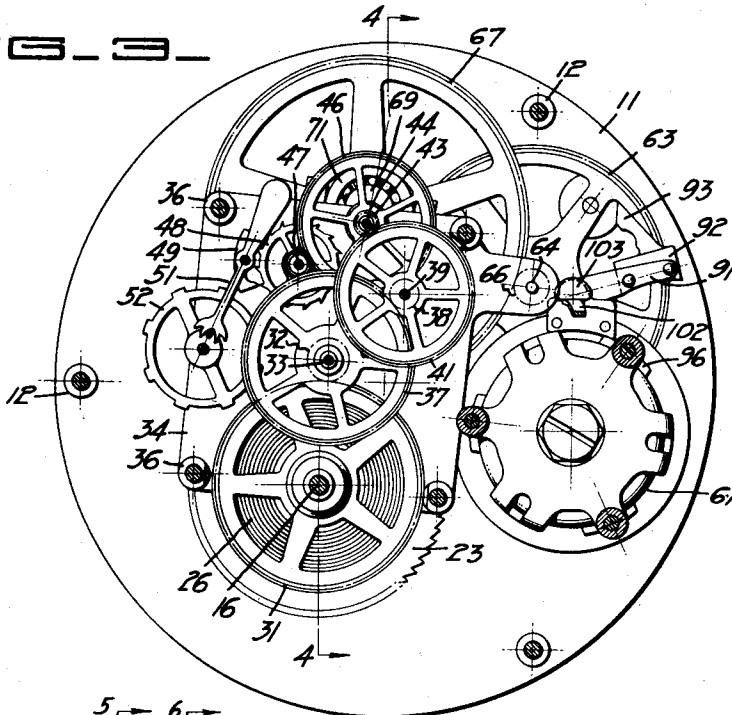
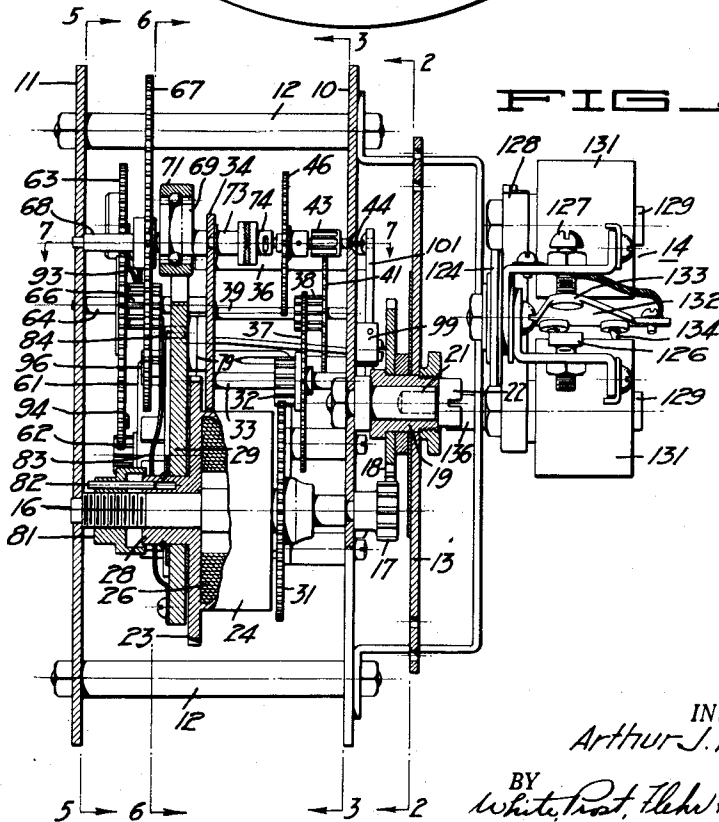


FIG. 4.



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FIG. 5.

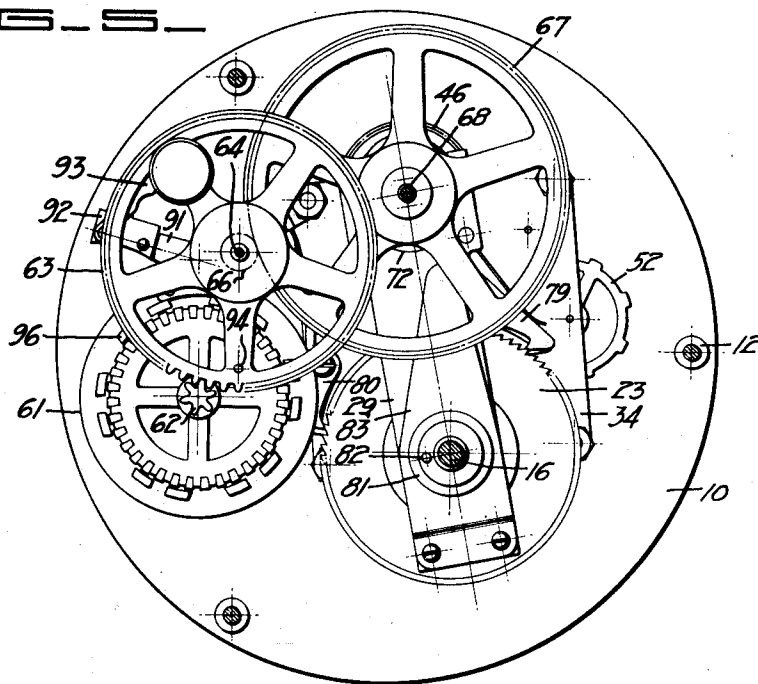
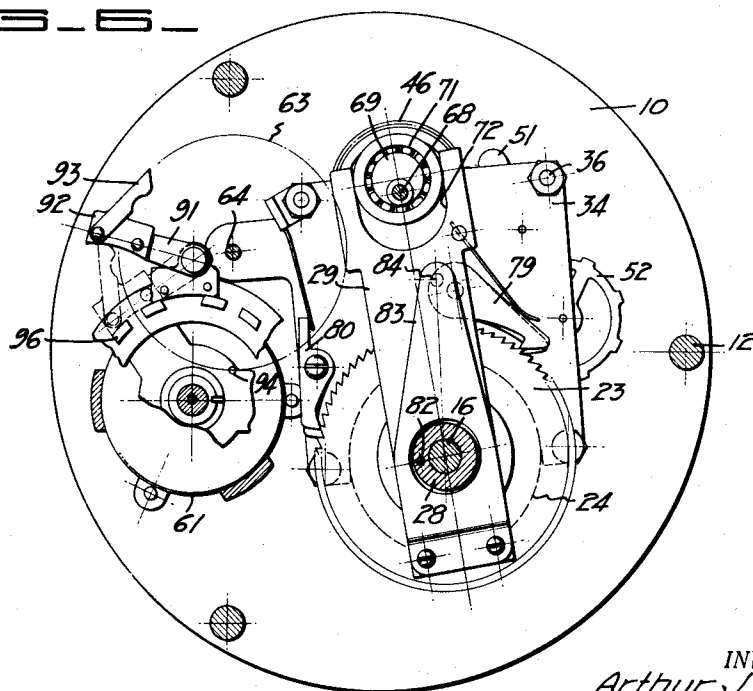


FIG. 5.



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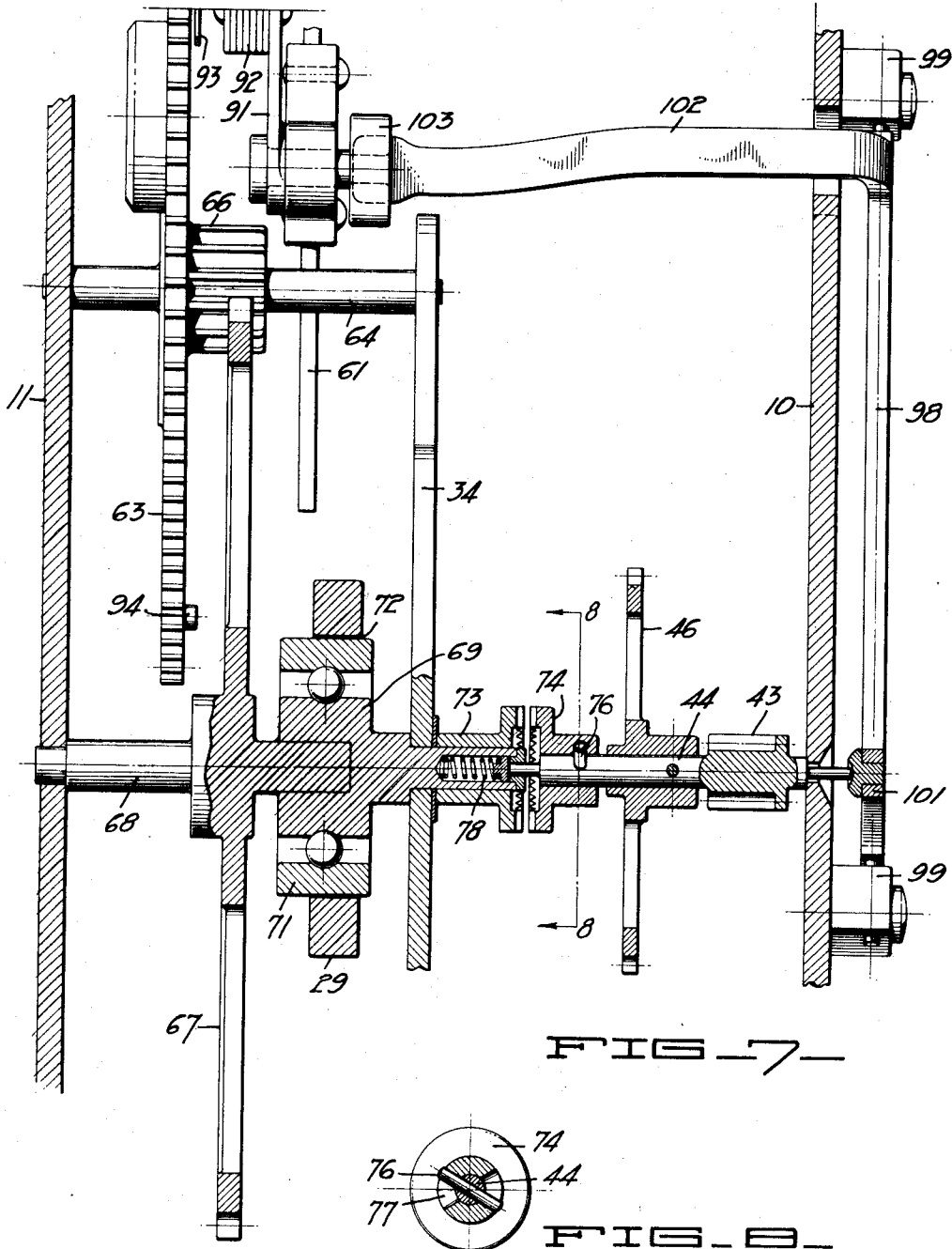


FIG-7-

FIG. 8.

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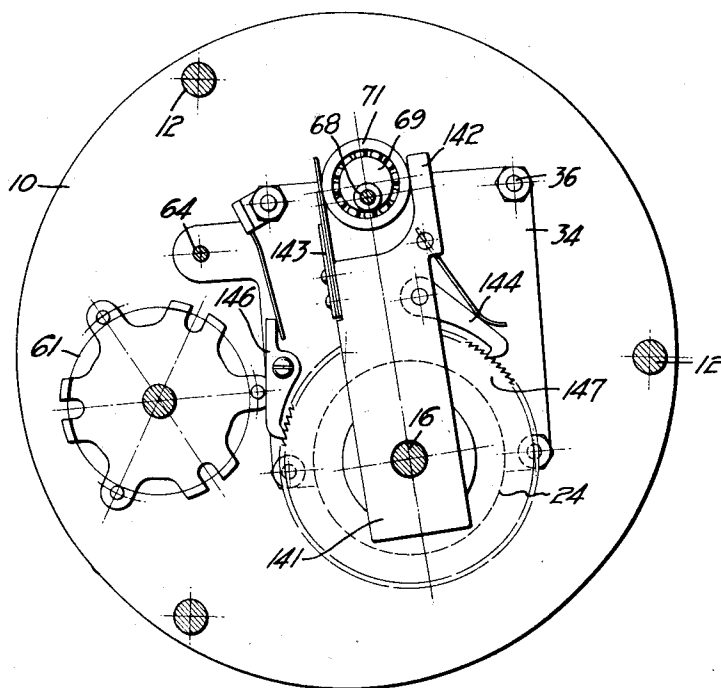


FIG. 8.

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UNITED STATES PATENT OFFICE

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TIMING DEVICE

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Application April 15, 1931, Serial No. 530,173

3 Claims. (Cl. 161-1)

This application relates generally to devices for effecting certain functions or operations in timed relationship or according to a given timed program. It can be utilized to advantage for effecting electrical switching operations at timed intervals, as for example to apply electrical current to an electrical water heater or electrical air heater only during certain periods of the day.

It is an object of the invention to devise an apparatus of the above character which will not require manual attention over long operating periods. In this connection the device is characterized by the fact that it operates from standard alternating current supply lines and will continue to function even during periods when the current supply is interrupted or fails.

It is a further object of the invention to construct a device of the above character which will be relatively simple as to mechanical elements, and therefore comparatively cheap to manufacture. Among other characteristics which contribute to attaining this object the invention utilizes a simple spring wound clockwork mechanism which drives a timing member and which is periodically stopped and started so that the timing member is driven at a proper average speed.

Further objects of the invention will appear from the following description in which the preferred embodiment of the invention has been set forth in detail in conjunction with the accompanying drawings. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a front elevational view illustrating a device constructed in accordance with the present invention.

Fig. 2 is a cross sectional detail taken along the line 2-2 of Fig. 4.

Fig. 3 is a cross sectional detail taken along the line 3-3 of Fig. 4.

Fig. 4 is a cross sectional detail taken along the line 4-4 of Figs. 1 and 3.

Fig. 5 is a cross sectional detail taken along the line 5-5 of Fig. 4.

Fig. 6 is a cross sectional detail taken along the line 6-6 of Fig. 4.

Fig. 7 is a cross sectional detail taken along the line 7-7 of Fig. 4.

Fig. 8 is a cross sectional detail taken along the line 8-8 of Fig. 7.

Fig. 9 is a cross sectional detail, similar to Fig. 6, showing a modification of the mechanism for

automatically winding the spring of the clockwork mechanism.

Referring to Fig. 4 of the drawings, the device illustrated therein consists of front and rear plates 10 and 11, secured together by means of the spacing members 12. Mounted in front of plate 10, there is a timing or program member in the form of a rotatable disc 13. As an example of means which is actuated at timed intervals thru rotation of disc 13, I have shown an electrical switch 14 which is mounted stationary with respect to the disc. Before describing in detail the parts which serve to drive disc 13, it may be explained in a general way that these parts include a spring driven clockwork mechanism connected to drive disc 13 as long as the clockwork mechanism is in operation. An electrical motor of the synchronous type, such as are commonly employed in electrical clocks, is associated with the clockwork mechanism and is intended to be permanently connected to the usual alternating current supply lines. Mechanism is provided whereby this motor serves to automatically wind the spring of the clockwork mechanism, so that the clockwork mechanism can continue to operate for a considerable time if the current supply should fail. Means also interconnects the electrical motor and the clockwork mechanism whereby the clockwork mechanism is periodically stopped and again started when the device is in normal operation. Thus the timing disc 13 is normally driven intermittently, rather than continuously.

The spring motive element of the clockwork mechanism includes a shaft 16, which is journaled in plates 10 and 11. Pinion 17 is fixed to one end of shaft 16, this pinion being adapted to engage the teeth of a gear 18. Gear 18, together with timing disc 13, are fixed to a common hub or sleeve 19. A stud shaft 21 is fixed to and extends outwardly from plate 10, and hub 19 is journaled to this shaft. Hub 19 is removably retained upon shaft 21 by means of screw 22.

Journaled upon shaft 16 between plates 10 and 11 there is a ratchet wheel 23, to one face of which is secured a spring casing 24. A flat spiral spring 26 is shown housed in casing 24, one end of this spring being connected to the casing, while the other end is secured to shaft 16. Journaled upon the hub 28 of gear 23, there is a rocker arm or lever 29, the purpose of which is to rewind the spring 26, as will be presently explained. To govern rotation of shaft 16 under the urge of spring 26, there is a reduction gearing, balance wheel, an escapement mechanism

similar to that ordinarily employed in spring wound clocks. For example a gear 31 is mounted upon shaft 16, and this gear engages a pinion 32 mounted upon shaft 33. Shaft 33 together with the other shafts of this gearing, is journaled in plate 10 and also in an intermediate plate 34 which is secured to plate 10 by means of spacer members 36. Gear 37 rotates together with pinion 32, and engages a pinion 38 carried by shaft 39. Gear 41 rotates together with pinion 38, and engages a pinion 43 mounted upon shaft 44. Gear 46 is likewise fixed to shaft 44, and engages a pinion 47 which in turn is directly connected to an escapement wheel 48 (Fig. 3). Rotation of escapement wheel 48 is controlled by an escapement pawl 49, lever 51, and spring biased balance wheel 52. The nature of the escapement and balance wheel is preferably such that if oscillation of balance wheel 52 is arrested, it will not automatically start under the urge of spring 26. However if after balance wheel 52 is arrested, a certain amount of torque is placed upon shaft 44 in the same direction as the direction of rotation that this shaft is urged by spring 26, the balance wheel will automatically start in operation.

The synchronous electrical motor 61 is preferably of the self starting type, and includes a shaft to which pinion 62 is mounted. Pinion 62 drives a gear 63, which is carried by rotatable shaft 64. Pinion 66, which rotates together with gear 63, serves to drive a gear 67 carried by shaft 68. An eccentric 69 is carried by shaft 68, and this eccentric carries a ball bearing assembly 71 which operates within a slot 72 formed in the outer end of arm 29. Thus, upon rotation of shaft 68 when motor 61 is operating, arm 29 is slowly rocked or oscillated continuously.

To one end of shaft 63 there is fixed a clutch element 73, which serves to co-operate with a corresponding clutch element 74, carried by shaft 44. As shown in detail in Figure 8, clutch element 74 has limited angular movement with respect to shaft 44, which is permitted by a pin 76 positioned within slot 77, the pin being fixed to shaft 44. A small spring 78 serves to normally urge shaft 44 in one direction, so as to tend to retain the faces of clutch elements 73 and 74 in disengagement. Upon longitudinal movement of shaft 44 in one direction, the faces of clutch elements 73 and 74 are engaged, so that element 74 is constrained to rotate at the same speed as shaft 68. As will be presently explained in greater detail, the parts including clutch elements 73 and 74, serve to cause the spring clockwork mechanism to be stopped periodically, and to be subsequently automatically started by a torque impulse applied to shaft 44.

It has previously been mentioned that oscillation of arm 29 serves to effect rewinding of spring 26. Thus as shown in Fig. 6 a pair of spring pressed pawls 79 engage the teeth of ratchet wheel 23, the ends of these pawls being offset a distance equal to substantially one-half the pitch of the ratchet teeth. Likewise pivotally mounted upon the stationary intermediate plate 34, are the checking pawls 80, which are likewise biased into engagement with the teeth of ratchet wheel 23. Therefore when arm 29 is rocked in one direction (the counterclockwise direction as viewed in Fig. 6) it carries with it ratchet wheel 23. When rocked in the opposite direction ratchet wheel 23 is held stationary by the checking pawls 80, while pawls 79 ride over the ratchet teeth. It is obvious that unless some

suitable means were provided, such a winding mechanism would soon wind spring 26 too tightly and cause mechanical breakage of certain parts. To disable the winding means when the spring has become wound to the proper degree of tension, there is shown a sleeve 81 which is threaded to shaft 16. Pin 82 prevents relative rotation between sleeve 81 and ratchet wheel 23, but permits a limited amount of movement of sleeve 81 longitudinally of shaft 16. Spring arm 83 is carried by arm 29, and is apertured to accommodate the hub 28 of ratchet wheel 23. The outer end of arm 83 carries a pin 84, and this pin extends thru an aperture in arm 29. When a given amount of relative rotation has taken place between shaft 16 and sleeve 81 such as occurs as spring 26 is being wound, spring arm 83 is forced towards arm 29 a sufficient amount to project pin 84 into engagement with pawls 79, thus frictionally retarding pivotal motion of these pawls, to prevent their proper ratcheting action. After spring 26 has become unwound a sufficient amount, pawls 79 are released so that the winding action can continue.

In order that rotation of disc 13 can continue during periods when electrical motor 61 is not in operation, means is provided whereby when current is applied to motor 61, clutch elements 73 and 74 are engaged, while when current is not applied, these elements are automatically disengaged. This means is preferably in the form of a pivoted trip arm 91 which carries an armature 92 made of suitable magnetic material. Spring finger 93, carried by arm 91, is adapted to be engaged by a pin 94 projecting from one face of gear 63. Assuming rotation of disc 63 in a counterclockwise direction as viewed in Fig. 6, in its rotation, pin 94 engages finger 93 and rotates arm 91 a sufficient distance to bring armature 92 in proximity with the poles 96 of the stator of motor 61. If the current is applied to motor 61 at this time, arm 91 will be magnetically held in the position shown in dotted lines in Fig. 6. As soon as the current to the motor is interrupted, arm 91 will return to the position shown in full line in Fig. 6 by virtue of a biasing spring.

Movement of trip arm 91 is converted to longitudinal movement of shaft 44 by means including a rocking bar 98 (Figs. 2 and 7). Pivotal connections 99 serve to mount bar 98 upon the outer side of plate 10. Arm 101 carried by bar 98 engages one end of shaft 44. Another arm 102 carried by rock bar 98 extends inwardly thru plate 10, and has its inner end engaging a cam 103 carried by trip lever 91. Therefore when trip lever 91 is moved to the position shown in dotted lines in Fig. 6, the motion transmitted thru rock bar 98 serves to force clutch elements 73 and 74 in engagement, while when trip arm 91 is in the position shown in solid lines in Fig. 6, clutch elements 73 and 74 are permitted to move to disengaged position.

The timing disc 13 can of course be constructed in various ways and provided with various means for effecting certain operations at different points in its travel. For example its peripheral edge portion has been shown provided with spaced markings 111, alternate ones of which are identified by numerals 112 to indicate hours. Cam members 113 and 114, provided with cam faces 116 and 117, are adjustably mounted upon disc 13. For adjustably retaining these members, the disc is shown provided with two rows of perforations

118 and 119 coinciding with markings 111, and certain ones of these perforations are engaged by screws or bolts 122 and 123.

While various forms of electrical switches or equivalent devices can be employed, the particular switch 14 illustrated is of novel construction, and is to be claimed in a subsequent application. To describe this switch briefly it consists of a base member 124, carrying a stationary contact 126 and an adjustable stop 127. A bar 128 has its medial portion pivotally connected to base plate 124. Pins 129 mounted upon the end portions of bar 128, carry spirally curved spring strips 131. A movable lever arm 132 carries a contact 133 adapted to cooperate with stationary contact disc 126. Pivot pins 134 carried by one end of lever arm 132, are fulcrumed in the opposed end portions of spring strips 131. One of the pins 129 is provided with a projecting stud 136, which extends in the path of movement of cam faces 116 and 117. In the position of bar 128 shown in full line in Fig. 1, it is evident that the bias of springs 131 upon pivot pins 134 tends to urge lever arm 132 against stop 127. As bar 128 is rocked in a clockwise direction it passes a dead center position beyond which lever arm 132 is moved rapidly to bring contact 133 into engagement with stationary contact 126. Such rocking movement of bar 128 takes place when cam surface 116 engages stud 136. When disc 13 has moved a further distance to bring cam surface 117 into engagement with stud 136, bar 128 is again rocked back to the position shown in full lines in Fig. 1, to cause contacts 126 and 133 to separate. Some of the advantages of such a switch are that the action is positive, the switch requires relatively small forces for its operation, and it will serve to make and break relatively heavy currents without arcing or sticking.

To outline operation of the complete device, it will be presumed that spring 26 is wound to a sufficient degree to properly operate the clockwork mechanism, and that motor 61 is connected to suitable alternating current supply lines. In this connection it should be explained that the alternating current supply lines should be a part of a distribution system in which the alternating current generators connected to the same are synchronized with a master clock. Such distribution systems are now common in the United States, where it has become standard practice to operate secondary electrical clocks of the synchronous motor type directly from alternating current supply lines. Trip lever 91 will be held in the position shown in dotted lines in Fig. 6, so that clutch elements 73 and 74 are retained in engagement. The clockwork mechanism drives disc 13 at a greater than the desired average rate. The gear reduction between electric motor 61 and shaft 16 is such that clutch element 73 is driven at a slower rate than the rate of rotation of shaft 44. In fact rotation of clutch element 73 is such that if it were to directly drive shaft 44 (and thus shaft 16, pinion 17 and disc 13 thru the interconnecting gearing) disc 13 would be driven at the desired average speed. At a given instant of operation it can also be presumed that pin 76 is positioned intermediate the ends of slot 77. Therefore at this time, although clutch element 74 is constrained to follow rotation of element 73, shaft 44 is free to rotate at a speed determined by the nature of the clockwork mechanism, and therefore at this instant disc 13 is being driven at a greater than desired average rate. Therefore a certain amount of

relatively slight rotation takes place between shaft 44 and clutch element 74. After a certain time interval of operation this relative rotation causes pin 76 to contact with one end of slot 77 and thereafter shaft 44 is immediately decelerated. Such deceleration causes balance wheel 52 to stop, which also results in stopping of the disc 13. Clutch elements 73 and 74 however continue to rotate, and thus after a predetermined time the other end of slot 77 is brought into engagement with pin 76. Such engagement causes a torque impulse to be transmitted to shaft 44, this torque impulse being sufficient to again start balance wheel 52 into operation, so that disc 13 is again put in rotation. Thus disc 13, although it is driven from a clockwork mechanism, is periodically stopped and again started, so that its average rate of progress is of the rate desired. During this operation the spring 26 of the clockwork mechanism may be wound by repeated oscillations of arm 29. Assuming now that the current to motor 61 should fail, causing the motor to stop operation, clutch elements 73 and 74 immediately disengage as has been previously explained, so that during this interval disc 13 is driven from the clockwork mechanism without interruption. When the current supply to motor 61 is again established, clutch elements 73 and 74 are again automatically engaged, so that thereafter disc 13 is driven intermittently. Obviously if the current is off or fails for a certain time period, movement of disc 13 will gain a certain amount, and subsequent intermittent operation would not make up for this gain. However such gain is not a serious amount even over long operating periods.

In Fig. 9 there is shown a modification of the means for effecting winding of the spring for the clockwork mechanism. In this case lever 141, corresponding to lever 29 of Fig. 6, is journaled directly on shaft 16, and sleeve 28 is omitted. Bearing assembly is interposed between a finger 142 fixed to lever 141, and a leaf spring 143 which is likewise carried by this lever. Pawls 144 and 146 are single rather than in pairs and the teeth on ratchet wheel 147 (corresponding to wheel 23 of Fig. 6) are of corresponding lesser pitch. The strength of spring 143 is such that when spring 26 is unwound it will cause lever 141 to oscillate during rotation of eccentric 69. When the spring has become wound to a sufficient degree spring 143 flexes and lever 141 remains substantially stationary.

I claim:

1. In a timing device, a timing member adapted to move cyclically, a spring driven clockwork mechanism connected to said member to drive the same at a rate greater than that desired, said mechanism being non-selfstarting, a synchronous alternating current motor, a mechanical connection between said motor and said mechanism whereby during operation of the motor said mechanism is periodically stopped and started, means for automatically disabling said connection when current is not applied to said motor, and means for causing the motor to wind the spring of said clockwork mechanism.

2. In a timing device, a rotatable timing member, a rotatable shaft adapted to turn together with said timing member, a member journaled concentrically with respect to said shaft and having a lost motion connection thereto, non-self-starting clockwork mechanism adapted to directly drive said shaft at a predetermined rate, a clutch element adapted to engage said last mem-

ber to effect rotation of the same, a synchronous electrical motor, and gearing connecting said motor to said clutch element, whereby when said clutch element is engaged with said member, said member is rotated at a rate less than the rate of rotation imparted to said shaft by said clockwork mechanism.

3. In a timing device, a timing member adapted to move cyclically, a non-selfstarting spring driven clockwork mechanism, means forming a

drive connection between said timing member and said clockwork mechanism, and means including a synchronous electrical motor for periodically applying oppositely directed torsional forces to said clockwork mechanism, to repeatedly start and stop the same, whereby the timing member is intermittently driven at a desired average rate.

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15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150