Jan. 6, 1953 A. B. BENSON 2,624,170

SECONDARY TIME-KEEPING APPARATUS

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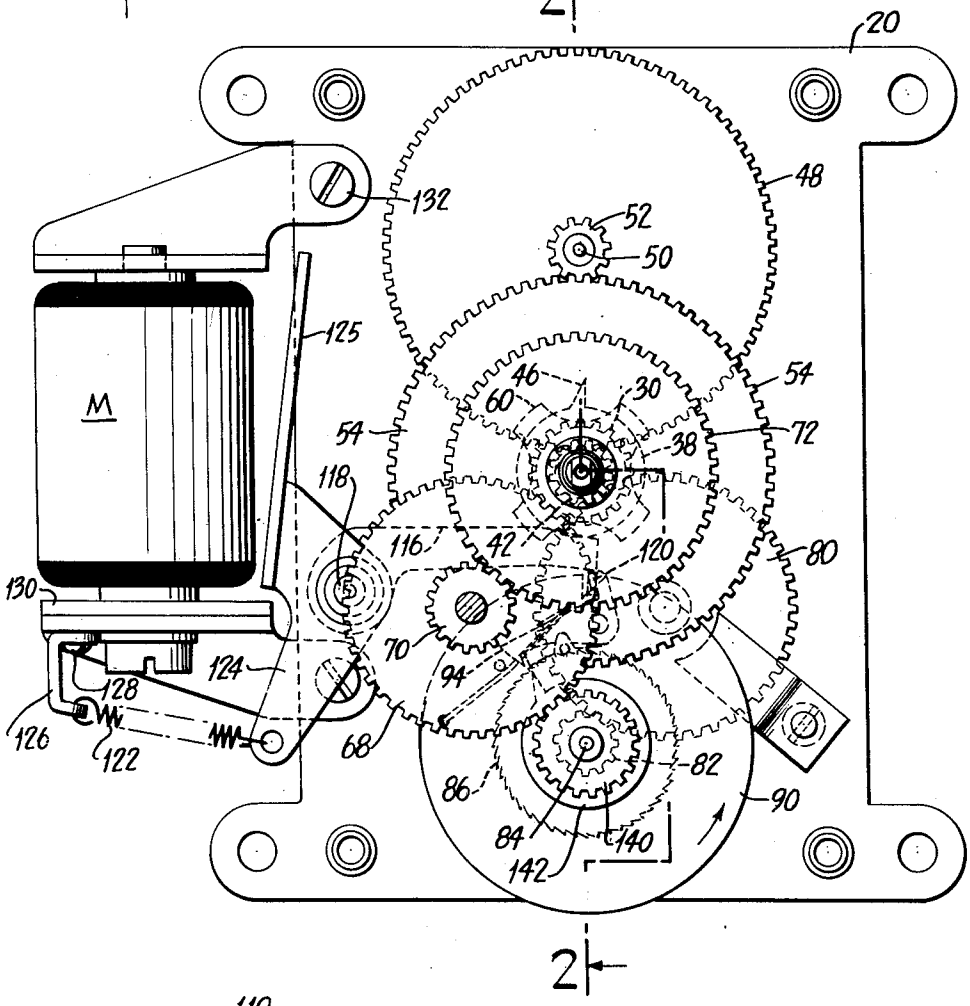
Fig. 1.



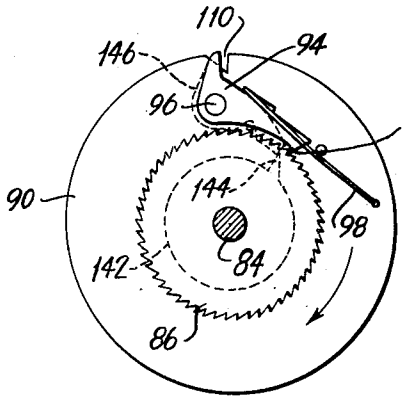


Fig. 5.

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SECONDARY TIME-KEEPING APPARATUS

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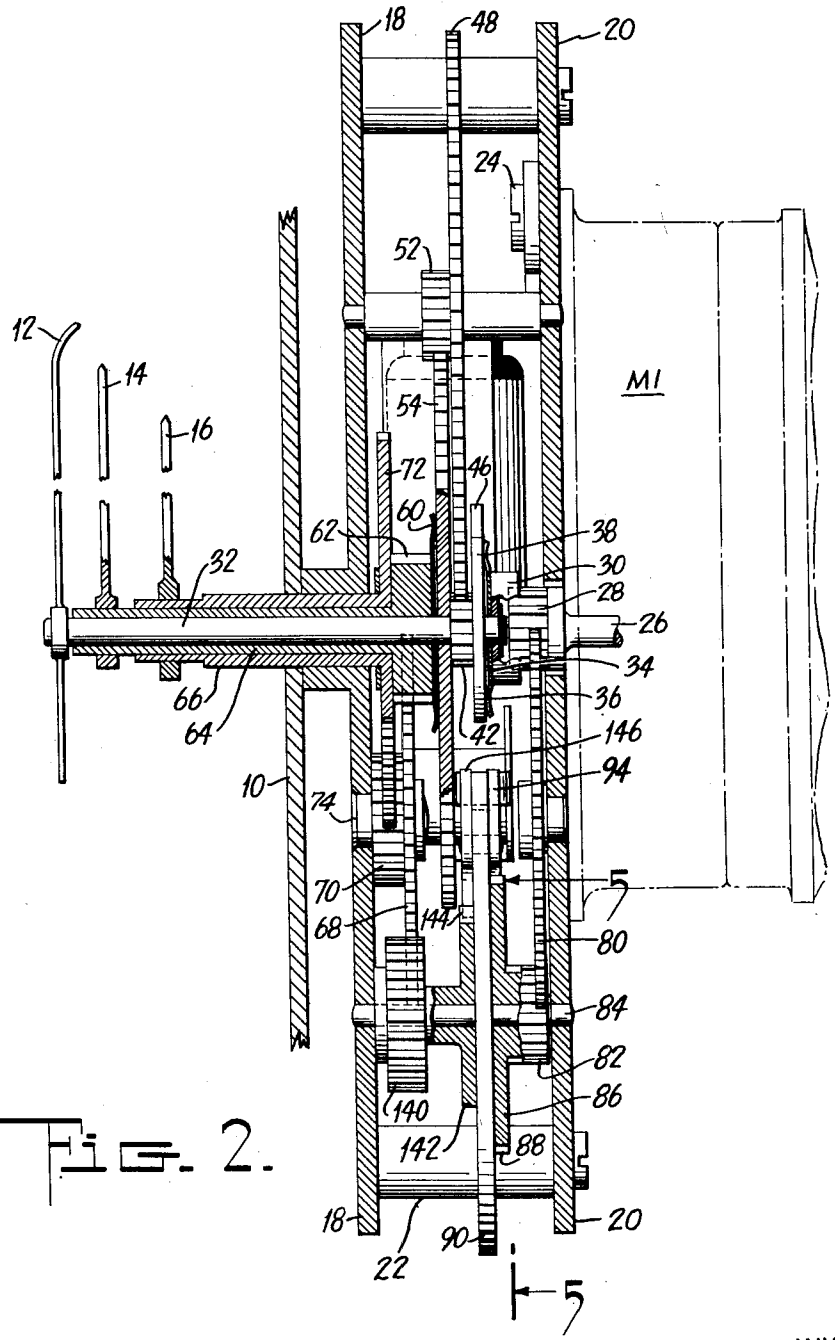

Fig. 2.

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SECONDARY TIME-KEEPING APPARATUS

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Fig. 3.

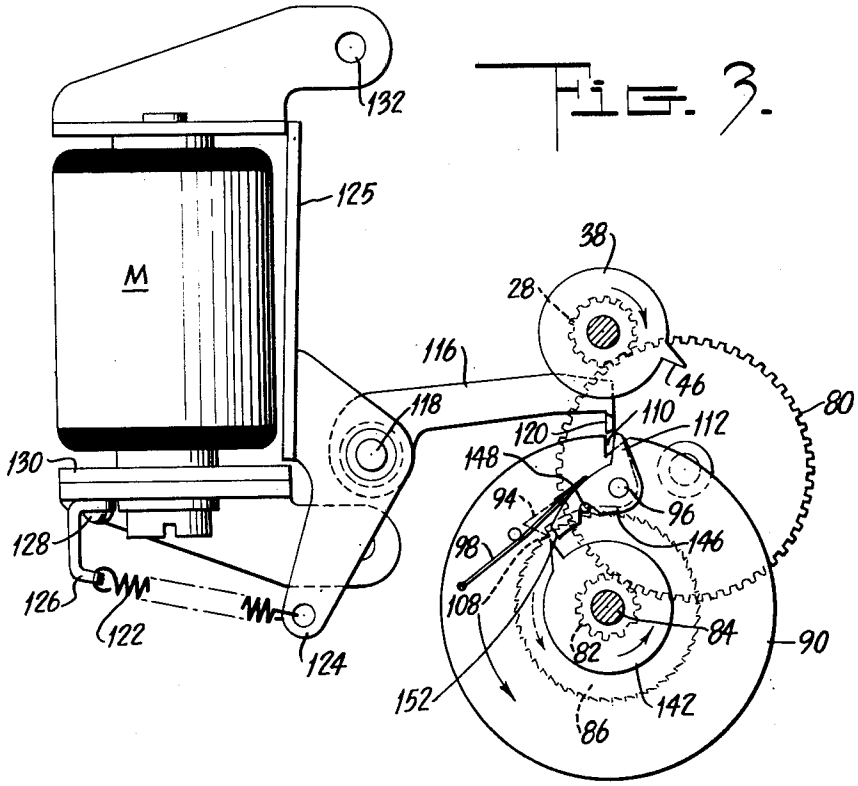
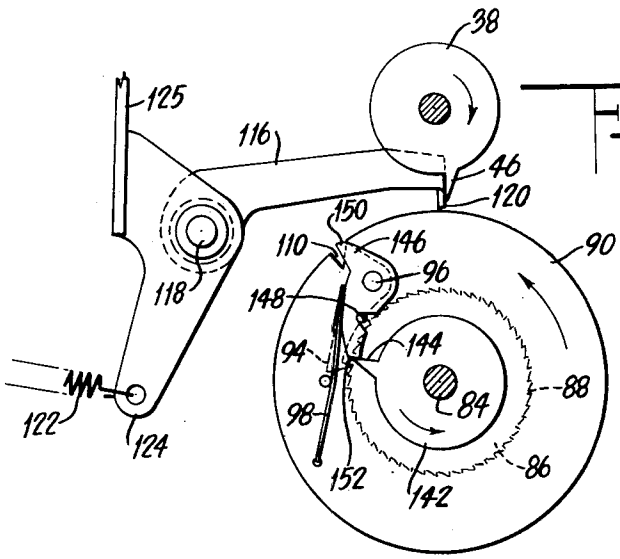


Fig. 4.



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2,624,170

SECONDARY TIME-KEEPING APPARATUS

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Application July 9, 1948, Serial No. 37,841

1 Claim. (Cl. 58—34)

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The present invention relates to time-keeping apparatus and, more particularly, to secondary clocks and similar time-keeping units of the type normally driven by individual driving motors, as for example, synchronous alternating current motors which are automatically regulated at selected intervals in response to time signals transmitted from a source of correct or standard time. The invention is designed as an improvement over the structure shown and described in a copending application of R. B. Johnson and E. F. Geiger, Serial No. 664,933, filed April 25, 1946, for Secondary Time-Keeping Apparatus.

In the copending application above referred to the clock mechanism is adapted to be uniformly and continuously driven by means of a synchronous alternating current motor which receives its impulses from the commercial 60-cycle power line. Means are also provided whereby an electrical signal is transmitted to the secondary clock over the regular power line at a moment which occurs slightly before the fifty-ninth minute of each standard time hour and which terminates precisely at the fifty-ninth minute of the hour, such an impulse serving to initiate a correction cycle whereby, if the secondary clock is running slow with respect to standard time at the fifty-ninth minute of the hour, it will be brought up to the correct time during the sixtieth minute of the hour so that when the sixtieth minute is completed and the first minute of the next succeeding hour commences, the clock will be accurately synchronized with the standard time source.

The special or time correcting signal which is imparted to the secondary clock over the regular commercial channel is preferably of a high frequency nature and it is employed to energize a magnet which, by tripping a latch, initiates the correction cycle.

Briefly, in the above mentioned copending application of R. B. Johnson et al., the clock mechanism includes a seconds shaft, a minutes sleeve and an hour's sleeve, all of which are concentrically mounted for movement at their respective rates of rotation about a common axis. The drive existing from the synchronous motor to the minutes sleeve which carries the minute hand includes a friction slip device by means of which the minutes sleeve is normally driven at its usual rate of rotation, i. e., one revolution per hour. However, during the correction cycle if the minute hand happens to be slow at the commencement of the cycle a clutch device is set into operation and this device picks up the minutes sleeve and rotates the same at a comparatively

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fast rate of rotation. The correction device includes a one revolution clutch mechanism which operates to clutch the minutes sleeve to the seconds shaft in operative driving relationship. As disclosed in the above mentioned application, the correction mechanism, including the clutch device, is mounted for operation about the same common axis as that of the seconds shaft and minutes and hours sleeves. The present invention is designed as an improvement over the structure shown in the above mentioned application in that the correction mechanism, including the one revolution clutch device, has been removed from the common axis of the rotatable time indicating elements and placed on a separate counter shaft, thereby materially relieving congestion around the axis of the clock hands. This feature constitutes one of the principal objects of the invention.

In the above mentioned copending application, means are provided during the correction cycle for interrupting rotation of the seconds shaft and, consequently, of the seconds hand when the latter arrives at the sixtieth second position and for holding the hand and shaft thus interrupted until the correction cycle is completed, after which the seconds shaft and hand are released precisely on time that they may resume rotation in coincidence with standard time at the commencement of an even hour. The present invention has, as an additional object, the provision of a simplified arrangement of parts for accomplishing the above mentioned feature and wherein the element which is employed for engaging the one-way, one revolution clutch during the correction cycle is also employed for blocking or otherwise interrupting the movement of the seconds shaft until such time as the correction cycle has been completed.

Other objects of the invention will be pointed out in the following description and claim and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a front elevational view of a secondary clock mechanism constructed in accordance with the principles of the present invention. In this view, the dial face clock hands, clock casing and other parts have been removed to more clearly reveal the nature of the invention.

Fig. 2 is an enlarged sectional view taken substantially along the line 2—2 of Fig. 1.

Figs. 3 and 4 are fragmentary views of the clock

mechanism of Fig. 1 showing the correcting mechanism and in various selected positions to illustrate the operation thereof.

Fig. 5 is a sectional view taken substantially along the line 5—5 of Fig. 2.

In all of the above described views, like characters of reference are employed to designate like parts throughout.

Referring now in detail to the drawings wherein a preferred form of an automatically regulated secondary clock construction is shown, the clock comprises the usual face plate or dial face 10, seconds hand 12, minutes hand 14 and hours hand 16. The parallel front and rear support plates are indicated at 18 and 20 respectively and they are suitably secured in their predetermined spaced relationship by pillars 22. An electric driving motor M1 is suitably supported, as for example, by means of screws 24, on the rear plate 20 and is preferably of the self-starting synchronous type which is adapted to be driven at a predetermined time rate from the available frequency regulated commercial alternating current power line.

The output shaft 26 of the motor M has mounted thereon a relatively wide splined pinion 28 which, when the motor is assembled on the rear plate 20, fits into and meshes with an internally threaded cup-shaped member 30 rotatably mounted on a seconds shaft 32, the latter being rotatably supported in the sleeves 64 and 66 mounted in the front plate 18.

A spider-like spring friction member 34 bears against one side of the cup-shaped member 30 and is formed with a series of spring fingers 36 which bear at their ends against one side of a disc 38 mounted on and secured to the shaft 32. The member 34 thus operates in the manner of a friction member for imparting movement from the cup-shaped member 30 to the shaft 32 and the latter is constrained to follow the rotational movements of the member 30 during normal time-keeping operations. The friction member 34 permits relative movement between the seconds shaft 32 and the pinion 28 when such relative movement is required for time-correcting operations, as will be subsequently described.

The disc 38 has formed thereon an outwardly extending stop finger 46. The seconds hand 12 is mounted upon the outer end of the seconds shaft 32. Thus the stop arm 46 and seconds hand 12 move together with the seconds shaft 32, and the stop finger 46 thus occupies a definite angular position with respect to the seconds hand 12 for any given time-indicating position of the latter.

A gear 42 carried by and fixed to the seconds shaft 32 and which may be considered as the seconds gear of the clock mechanism is in mesh with a large gear 48 (Figs. 1 and 2) mounted on a shaft 50 extending between the front and rear plates 18, 20 of the clock works mechanism. The shaft 50 carries a small gear 52 which meshes with a large gear 54 loosely disposed on the seconds shaft 32. A minutes sleeve 64 surrounds the seconds shaft 32 and has formed thereon a minutes gear 62. A spider-like friction member 60 is interposed between the gear 54 and the gear 62 and permits relative motion between the constantly rotating gear 54 and the gear 62 when necessary during the time-correction cycle or period, as will appear presently.

An hours sleeve 66 is rotatably mounted on the minutes sleeve 64 and is driven at the proper time rate of one revolution every twelve hours by gearing including a large gear 68 which meshes with the minutes gear 62 and a small gear 70 which meshes with the relatively large hours driving gear 72 carried on the hours sleeve 66. The gears 68 and 70 are carried on a common stub shaft 74 secured in the front plate 18. The hours hand 16 is mounted on the forward end of the hours sleeve 66 which terminates short of the minutes sleeve 64.

Referring now to Figs. 1 and 2, the pinion 28 which is carried by the motor shaft 26, in addition to driving the cup-shaped gear 30, as previously described, meshes with and drives a relatively large gear 80 journaled on the rear plate 20. The gear 80 in turn meshes with a small gear 82 fixedly mounted on a countershaft 84 extending across the clock works and rotatably journaled in the front and rear plates 18 and 20 respectively. The gear 82 is formed with a disc portion 86 thereon having a series of relatively small peripheral teeth 88 thereon. The teeth 88 are relatively small and closely spaced and these teeth are designed for clutching engagement with a relatively small pawl-like clutch piece 94 which is pivoted as at 96 to one side of a relatively large time-correcting disc 90 which is loosely mounted on the constantly rotating counter shaft 84 immediately to one side of the toothed disc 86. The clutch piece 94 is spring pressed as at 98 in a counter-clockwise direction, as viewed in Figs. 3 and 4, and is provided with a clutch tooth 108 which bears against the periphery of the toothed disc 86, thereby permitting engagement between the two discs 86 and 90 so that the latter is clutched to follow the movements of the former.

The periphery of the disc 90 has formed therein a slot 110 across which one end 112 of the clutch piece 94 extends. A lever 116 is mounted on a rock shaft 118 extending across the frame pieces 18, 20, and is provided with a laterally turned end 120. A coil spring 122 is anchored at one end thereof to an extension 124 of an armature 125 associated with an electromagnet M, the armature being mounted on the rock shaft 118. The other end of the coil spring 122 is anchored to a bracket 126 which is secured as at 128 to the magnet support 130, this latter support being secured as at 132 to the frame piece 20.

From the above description of parts it will be seen that the spring 122 by exerting a pulling effect on the extension 124 of the armature 125 normally causes the armature to be moved in a clockwise direction, as viewed in Fig. 3, thus moving the rock shaft 118 in such a direction as to cause the laterally turned end 120 of the arm 116 to enter the slot 110 and by a camming action urge the clutch piece 94 in a clockwise direction to withdraw the tooth 108 thereon from engagement with the toothed periphery of the disc 86. The laterally turned end 120 of the arm 116 when in the slot 110 also serves to hold the disc 90 stationary in a fixed angular position. Upon energization of the electromagnet M, its armature 125 will be swung in a counter-clockwise direction, thus moving the rock shaft 118 in a counter-clockwise direction and causing the laterally turned end 120 of the arm 116 to be withdrawn from the slot 110, thereby permitting the clutch piece 94 to be moved under the influence of the spring 98 in a counter-clockwise direction so that the tooth 108 engages the toothed periphery of the disc 86 and effectively couples the two discs 90 and 86 so that they will rotate in unison. Once the laterally turned end 120 of the arm 116 has left the slot 110, the coupling between the two

parts 86 and 90 is complete and the latter disc commences to rotate. Upon deenergization of the electromagnet M the laterally turned end 120 thereof will bear against the smooth periphery of the disc 90 and slide thereon until such a time as the latter disc has executed one complete revolution, at which time the slot 110 will again come into register with the laterally turned end 120 of the arm 116 so that the end 120 may again enter the slot and disengage the driving connection between the continuously rotating disc 86 and the disc 90. The clutch piece 94 and disc 86, therefore, in effect constitute a one-revolution clutch which becomes effective upon initial energization of the magnet M to couple the parts together and which becomes effective at the end of one complete revolution of the disc 90 to uncouple the two parts.

Referring now to Figs. 2 and 4, the countershaft 84 has loosely disposed thereon a gear 140 which meshes with the gear 68 and which in turn meshes with the minutes gear 62. The gear ratio between the gears 140, 68 and 62 is such that the gear 140 is adapted to rotate once every hour. In other words, the gear 140 is operatively connected to the minutes sleeve 64 by a 1:1 gear ratio and the particular orientation of the gear 140 at any instant is always dependent upon the orientation of the minutes sleeve 64. During normal time-keeping movements of the minutes sleeve 64, the gear 140 moves according to chronological time and follows the movements of the minutes sleeve 64. During the time-correcting cycle if the minute hand 14 is slow with respect to chronological time, the gear 140 is caused to drive the minutes gear 62 at a comparatively rapid rate of rotation to in turn drive the minutes sleeve 64 and bring the minutes hand 14 up to proper chronological time at the end of the time-correcting cycle. Toward this end, the gear 140 has integrally formed therewith a time-correcting disc 142 on which there is formed a radially projecting finger 144. A pivoted dog 146 is mounted on one side of the time-correcting disc 90 and is spring biased in a counter-clockwise direction, as viewed in Fig. 4. A limit stop in the form of a pin 148 formed on the disc 90 serves to limit the extent of inward movement of the dog 146 relative to the center of the disc 90. The dog 146 has a portion 150 thereof extending across the peripheral slot 110 and this portion 150 of the dog 146 is designed for camming engagement with the laterally turned end 120 of the arm 116 so that when this end 120 is disposed within the slot 110, the dog 146 is maintained in a retracted position. When the laterally turned end 120 is withdrawn from the slot 110 upon energization of the magnet M in the manner previously described, the dog 146 is permitted to move to its normal position wherein the extreme end 152 thereof is projected into the path of movement of the finger 144 formed on the disc 142. During the time-correcting cycle when the disc 90 has been released by the laterally turned end 120 of the arm 116 with the clutch piece 94 effecting clutching engagement between the two discs 90 and 86, the end of the dog 146 will overtake the relatively slowly moving finger 144 of the disc 142 and engage the same and thereafter forcibly carry the disc 142 in a clockwise direction, as viewed in Fig. 5, thus turning the gear 140 to in turn drive the gears 68 and 62 and, consequently, turning the minutes sleeve 64 at the rate of one revolution per minute to bring the minutes hand 14 up to chronological or standard time at the end of the correction cycle. The correction cycle is terminated by movement of the laterally turned end 120 of the lever 116 into the peripheral slot 110 in the cam 90, thus moving the dog 146 to its retracted position and releasing the finger 144 which then resumes its normal movements at the rate of one revolution per hour.

Referring now to Figs. 1, 2 and 3, the diameter of the disc 38 and the extent of the stop finger 46 which moves in unison with the seconds hand 12 is such that when the laterally turned end 120 of the arm 116 is withdrawn from the slot 110 and rests against the periphery of the disc 90 this laterally turned end is directly in the path of movement of the stop finger 46. Conversely, when the laterally turned end 120 is disposed within the slot 110, this end clears the finger 46 and presents no obstruction to normal rotation of the disc 38 and, consequently, of the seconds hand 12 at its normal rate of rotation of one revolution per minute. Immediately upon commencement of the correction cycle after the magnet M has become energized, the laterally turned end 120 of the arm 116 will be projected into the path of movement of the seconds hand 12 which, depending upon the particular position of the seconds hand at the time the correction cycle commences, will ultimately come to rest against one side of the laterally turned end 120 of the arm 116 and arrest further movement of the disc 38 and, consequently, of the seconds hand 12 until such time as the correction cycle has been completed and the laterally turned end 120 again enters the slot 110 in the disc 90.

From the above description of parts it will be seen that the arm 116 performs a fourfold function. Firstly, by its position within the slot 110, it serves to obstruct movement of the disc 90 and hold the latter stationary at all times, except during the correction cycle. Secondly, when this laterally turned end 120 is withdrawn from the slot 110 at the commencement of the correction cycle, it releases the clutch piece 94 for engagement with the periphery of the toothed disc 86, thereby connecting the discs 86 and 90 for movement in unison during the correction cycle. Thirdly, the laterally turned end 120 serves to move the pivoted dog 146 into and out of the path of movement of the finger 144 to thus effect driving engagement between the disc 90 and the disc 142 to impart the relatively rapid rate of rotation of the former to the latter to bring the minutes hand rapidly up to chronological or standard time during the correction cycle. Fourthly, the laterally turned end 120 of the arm 116 serves to block movement of the finger 46 during the correction cycle to arrest movement of the seconds hand at the zero position of the clock dial and to hold the seconds hand thus arrested until the correction cycle has been completed, after which time the seconds hand is released and permitted to proceed around the face of the clock dial in the normal manner in exact coincidence with chronological or standard time.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the apparatus illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to

be limited only as indicated by the scope of the following claim.

What is claimed is:

In a time-keeping apparatus, a driving motor adapted to operate continuously at a uniform time rate, a time member mounted for rotation about an axis, a driving connection including a friction slip device between said motor and time member for driving the latter at its normal time-keeping rate, and a second driving connection between said motor and time member for driving the latter at a rate faster than its normal time-keeping rate, said latter driving connection comprising a pair of clock-advancing members mounted for rotation about a common axis removed from the axis of rotation of said time member, means operatively connecting one of said clock-advancing members to the time member for rotation thereof chronologically in unison, normally disconnected one-revolution clutch means operatively connecting the other clock-advancing member and motor in driving relationship, a one-way lost-motion coupling between said clock-advancing members for driving of the time member from the motor through said clock-advancing members, and signal-responsive means for periodically rendering said clutch means operative.

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