

June 14, 1938.

E. A. FALLER

2,120,353

SYNCHRONIZING CLOCK

Filed Dec. 18, 1935

2 Sheets-Sheet 1

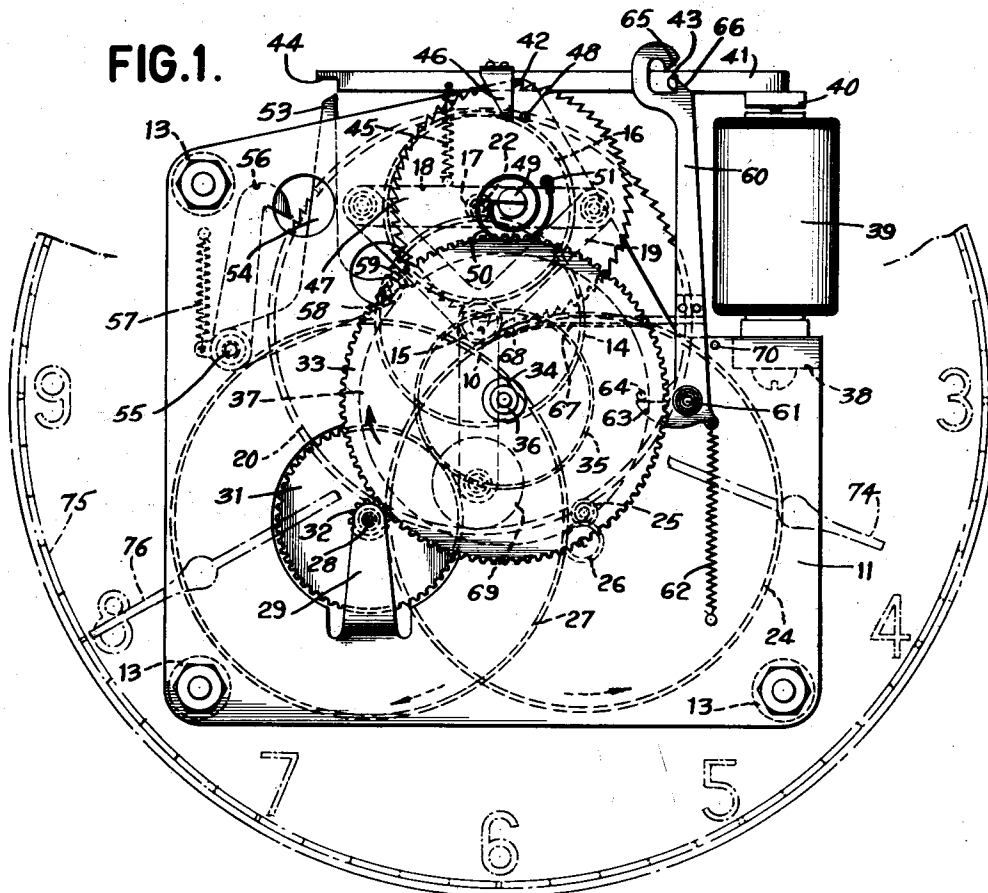
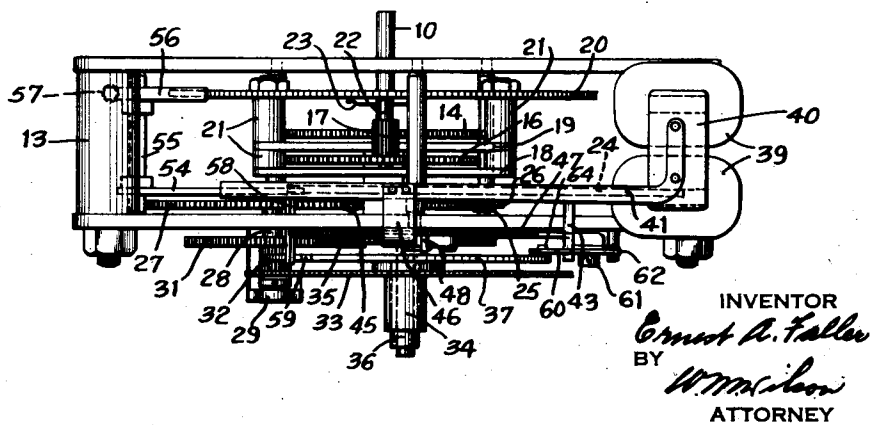


FIG. 4.



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2 Sheets-Sheet 2

FIG. 2.

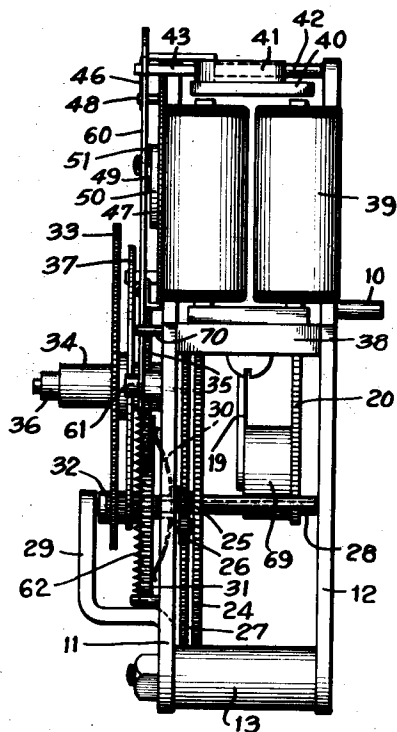


FIG. 3.

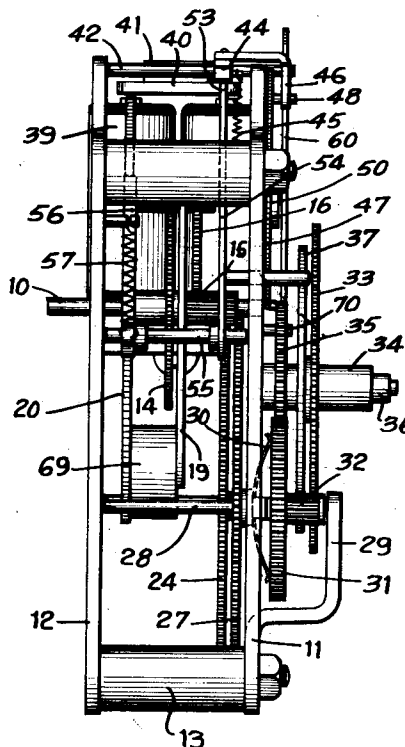


FIG. 5.

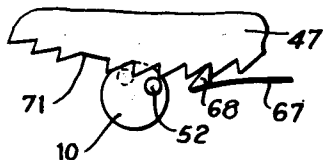
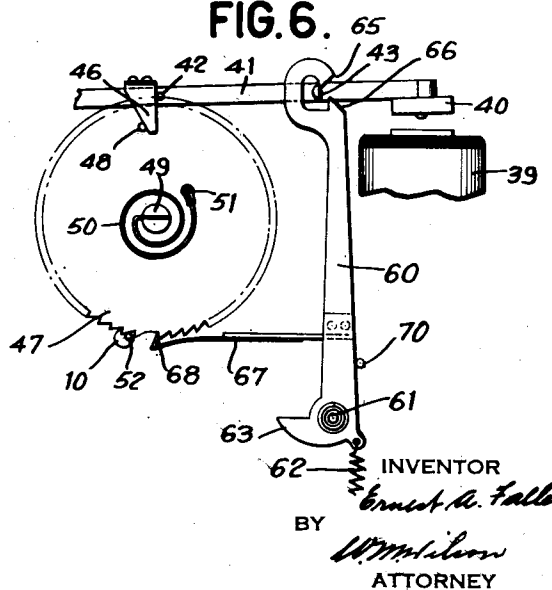


FIG. 6.



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2,120,353

SYNCHRONIZING CLOCK

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Application December 18, 1935, Serial No. 54,995

7 Claims. (Cl. 58—35)

This invention relates to clocks and more particularly to clocks which may be corrected hourly by electric current impulses from a remote source.

In the use of time systems and particularly in the use of systems in which the clocks are operated from an electric power network of well-regulated frequency, the occasional interruptions of the supply from uncontrolled and unsupervised sources cannot be prevented. Different characteristics and conditions under which clocks operate also effect their time keeping qualities; so that synchronous motor drive clocks operating on the same circuit may differ from each other. Dirt or foreign matter temporarily lodged in the gear train may cause a load sufficient to cause a slippage of the armature in the rotating field of the motor to cause the clock to run slow. Unauthorized setting of the hands of a clock is sometimes resorted to where a deliberate attempt to mislead as to the time is desired by the one making such a setting. To compensate for such instances it is necessary to provide means for individually and automatically correcting each clock periodically and for providing means whereby an unauthorized setting of a clock cannot be made to exceed the correcting range of the clock.

An object of the invention is to provide means for hourly correcting a clock by means of electric current impulses.

Another object is to provide blocking means for preventing unauthorized setting of a clock by an amount exceeding the corrective range of said clock.

A still further object is to provide means for continued operation of the clock upon failure of the corrective mechanism to function on account of current failure or other reasons.

Other objects and advantages of this invention will be apparent from the specifications and the accompanying drawings which show one embodiment of this invention and wherein similar reference numerals indicate similar parts and wherein in the drawings:

Fig. 1 shows a front elevation of the clock mechanism.

Fig. 2 shows a side elevation looking towards the right side of Fig. 1.

Fig. 3 shows a side elevation looking towards the left side of Fig. 1.

Fig. 4 shows a plan view of the clock movement.

Fig. 5 shows an enlarged view of a detailed part of the mechanism.

Fig. 6 shows a detail of parts of Fig. 1 in a different position.

There are various and numerous methods of synchronizing a network of clocks. The present device could readily be applied to most of the systems. In the present instance it may be contemplated that this device may be driven by a well known type of synchronous motor operating from a light and power network and directly connected to the main shaft 10 and that the magnet 39 may be in a timed circuit and responsive only to a current of a frequency substantially higher than the commercial current frequency. Such a method would require time controlled equipment for effecting impulses of such high frequencies over the light and power network. A complete and detailed description of such a control equipment may be found in the copending application of L. S. Harrison, Serial No. 17,245, filed April 19, 1935.

Instead of the above method of synchronization the magnet 39 may be controlled by a third wire or additional circuit carrying impulses of the same commercial current as carried in the network.

The present mechanism might also have its shaft 10 connected with a spring drive clock mechanism either hand wound or motor wound, and periodically corrected by means of current impulses under control of a suitable time controlled mechanism.

Inasmuch as the method and means of controlling synchronization externally of the present device plays no part in the present invention it is deemed unnecessary to complex the description of the device with additional unnecessary description of existing art, as it will be accordingly assumed that the shaft 10 is directly connected to an alternating current synchronous motor or any other suitable device which normally turns shaft 10 at a continuous and constant speed of substantially one-revolution per minute in a clockwise direction.

The shaft 10 is journaled in plates 11 and 12 which are spaced apart and held in rigid alignment by pillars 13 all of which constitute the supporting framework of the mechanism. A gear 14 is fixed to the shaft 10 and a pinion 15 is rotatably mounted on said shaft and is connected to the gear 14 by means of the gears 16 and 17. The gears 16 and 17 are fixed to a shaft 22 which is journaled at one end in a bridge 18 mounted on a spider 19. The bridge and spider are mounted on a ratchet wheel 20 by means of pillars 21 and the ratchet wheel 20 is rotatably mounted

on the shaft 10 as also is the spider 19. The opposite end of the shaft 22 is journaled in the ratchet wheel 20 and said shaft has fixed there-to a leaf spring 23 which bears against the side of the ratchet wheel. As the shaft 10 rotates, the gear 14 will tend to rotate the gear 17 but due to the slight friction of the spring 23 the gear 14 does not rotate relative to the spider but the whole spider assembly will rotate so that the gears 14, 17, 18, and 15 remain motionless relative to each other with the result that the pinion 15 is rotated at the same speed as the shaft 10, namely, 1 R. P. M.

Minute hand 76 and the hour hand 74 are mounted on arbors 36 and 34 respectively and cooperate with a suitable clock dial 75 which may be suitably mounted adjacent said hands, to indicate the time.

The clock hands are driven from the pinion 15 through the following gear train: Gear 24 engaged with pinion 15 and fixed to a shaft journaled in the frame plates 11 and 12, pinion 25 fixed to the same shaft to rotate with gear 24, idler gear 26 pivotally mounted on a stud in plate 11 and engaging pinion 25 and gear 27, gear 27 fixed to a shaft 28 which is journaled in the plate 12 and a struck-out portion 29. Fixed, by means of a bushing to the shaft 28 is a spring 30 (Fig. 3) which frictionally bears against the face of a gear 31 rotatably mounted on the shaft 28 and having integral with it a pinion 32. The pinion 32 engages a gear 33 on which is mounted the hour hand arbor 34 and the gear 31 engages a gear 35 on which is mounted the minute hand arbor 36. The gear 31 is rotated with the shaft 28 by virtue of the friction spring 30. A cam disc 37 is mounted on the minute hand arbor and rotates 1 revolution per hour with the gear 35, the purpose of which will be described later.

A magnet yoke 38 is mounted between the plates 11 and 12 and supports thereon a magnet 39 which cooperates with an armature 40 fixed to a lever 41 pivoted at 42. The lever 41 is provided with a semi-cylindrical pin 43 located between its pivot and the armature and has an offset 44. The lever 41 is biased in a counterclockwise direction by means of a spring 45 anchored between studs mounted on the front side of the lever and the back side of plate 11. Fixed at the top of the lever 41 is a cam 46 which extends across the top of plate 11 and a ratchet wheel 47 and is formed downwardly to extend into the orbit of a pin 48 mounted on said ratchet wheel.

The ratchet wheel is pivotally mounted on a stud 49 and is normally biased in a clockwise direction by a coil spring 50 anchored to the ratchet wheel at one end by pin 51 and fixed at the other end to the clutch 49. The teeth in this ratchet wheel are adapted to be engaged by a pin 52 eccentrically mounted in the shaft 10 (Fig. 5) so that upon each revolution of the shaft the pin will rotate the ratchet wheel 47 an angular distance equivalent to one tooth. The shaft 10 terminates at its forward end flush with the plate 11. The extent of rotation of the ratchet wheel 47 is limited in both directions by the cam plate 46.

The offset end 44 of lever 41 is adapted to be engaged by one end 53 of a lever 54 lying in the plane of lever 41 and fixed to a shaft 55 journaled in the plates 11 and 12. Fixed to said shaft 55 is a pawl 56 lying in the plane of the ratchet wheel 20 and adapted to engage the teeth thereon. A spring 57 attached between

said pawl and a stud in plate 12 normally biases the pawl 56 and shaft 55 in a clockwise direction. The pawl 56 may be prevented from engaging the teeth of ratchet wheel 20 by the engagement of the lever 54 by the offset 44 or by the engagement of a pin 58 mounted on an arm of lever 54, with a projection 59 of a cam plate 37, as shown in Fig. 1. The pin 58 extends through an aperture in the plate 11 to the cam 37.

A lever 60 is pivotally mounted on a stud 61 mounted on plate 11 and is biased in a clockwise direction against a stop 70 by a spring 62. A projection 63 integral with said lever extends into the orbit of a pin 64 mounted on the cam plate 37. At its upper end the lever is provided with a hook 65 and a projection 66. Normally the lever 60 takes the position shown in Fig. 6. A leaf spring 67 is mounted on the lever 60 and is provided with a pawl 68 which engages the teeth of the ratchet wheel 47 when the lever 60 is in its normal position as shown in Fig. 6. When said lever is rocked to the left the pawl 68 becomes disengaged from the ratchet wheel as shown in Fig. 1.

A counterbalance 69 is provided at the bottom of the spider 19 to balance the weight of the bridge 18 and the gear wheel mounted thereon.

Operation

Normally the magnet 39 is deenergized so that the armature is in the position shown in Fig. 6. Any suitable master clock such as for example is shown in patent to J. W. Bryce, No. 1,390,018, dated September 6, 1921, may be used which will close a contact for one-minute duration over a circuit running to the magnet 39 to initiate a flow of current from a suitable source for that duration. Such provisions are old and well-known in the art and further description of the same is deemed unnecessary for a clear understanding of the present invention. In the present invention the master clock will close such a circuit when the chronological position of the master clock is at the 59th minute and open at the even hour. Thus, the operation of the magnet 39 is limited to energization for a one-minute period each hour.

In the patent above cited a cam on the minute hand shaft cooperating with a single contact will suffice.

The projection 59 on the cam 37 will arrive under the pin 58 on lever 54 at the chronological position of the motor drive clock of 30 seconds after the 59th minute. The secondary clock normally running rotates the pinion 15 at the same rate the main shaft 10 rotates with the spider 19 rotating about its axis.

The cam 37 is movable with the hands or time indicating mechanism of the clock and is operable independently of the ratchet wheel 47 by means of the friction drive spring 30, that is so that the cam 37 may be blocked and so block the advance of the time indicating mechanism, whereas the main shaft 10 will keep turning and consequently advance the ratchet wheel 47. The pin 64 on cam 37 will reach and impinge on the projection 63 when the chronological position of the time indicating members, or the minute hand of the motor drive clock reaches approximately its 59th minute position. The lever 60 will be urged in a counterclockwise direction but the hook 65 will engage the pin 43 (Fig. 6) and prevent this. Thus, if the clock has been set ahead by some unauthorized person, it can move no further than this position and it will

be halted there until the master clock reaches its 59th minute position, whereupon the magnet 39 becomes energized and the pin 43 on lever 41 will be moved downwardly into the path of the projection 66. At this time the lever 60 still urged by the motor driving the friction spring 30 will move to the left, permitting the cam 37, and thus the hands of the clock, to move forward one minute halting the clock at its even hour position by virtue of the pin 43 impinging against the projection 66, as shown in Fig. 1. When the master clock reaches its even hour position the circuit to magnet 39 is opened, and said magnet deenergized, permitting the pin 43 to rise and become disengaged with the projection 66.

The lever 60 being now unrestrained, permits the cam 37 to resume its rotation and the pin 64 will continue to move the lever 60 to the left until the pin is disengaged from the projection 63 after which the lever 60 will be swung to the right by spring 62 against the stop pin 70 and will take the position shown in Fig. 6. When the lever 60 rocks clockwise the cam shaped end 65 strikes the circular side of pin 43 camming it downward slightly so that it passes under the nose of the hook. The movement of the lever 41 about its pivot is not sufficient however to disengage the offset 44 from the end 53 of lever 54. When the motor drive clock will be arrested by the pin 64 against projection 63 of lever 60, the chronological position of the clock will be at the 59th minute and therefore the projection 59 on cam 57 will not yet have arrived under pin 58. If the clock is ahead of the master clock the 59th minute impulse will not as yet have been initiated so that magnet 39 will not be energized and the end 53 of lever 54 will be engaged by the offset 44. When the 59th minute impulse energizes the magnet 39, the lever 54 will be released and move clockwise to cause pawl 56 to engage ratchet wheel 20 causing the hands to move ahead rapidly the equivalent of 30 seconds, in a manner to be explained later, until the projection 59 lifts the pin 58 to rotate lever 54 counterclockwise and disengage the pawl 56 after which the clock resumes advance at normal speed while the pin 64 bears against the projection 63 moving the lever 60 counterclockwise until the projection 66 strikes the pin 43 halting the progress of the time indicating mechanism of the clock at its 60 minute chronological position. Upon the deenergization of the magnet 39 the offset 44 again engages the lever end 53 and the clock resumes its normal advance as previously explained.

If the motor drive clock is slow at the time magnet 39 is energized the projection 59 will not have reached the pin 58, consequently, when the lever 41 is rocked clockwise the offset 44 disengages the end 53 of lever 54 and said lever is rocked clockwise by spring 57 causing the pawl 56 to engage the ratchet wheel 20 and arrest its rotation. The stopping of this ratchet wheel arrests the rotation of the spider and causes the pinion 15 to be rotated at such a speed that the minute hand arbor and therefore cam 37 now rotates at the rate of one-revolution per minute instead of one-revolution per hour.

The drive of the pinion 15 is now effected through the gear train in which gear wheel 14 fixed to drive shaft 10, still turning at 1 R. P. M., drives pinion 17 fixed to gear 16 which in turn drives pinion 15. The motor drive clock thus rapidly advances until the projection 59 strikes the pin 58 thus rocking lever 54 counterclockwise

and withdrawing the pawl 56 from the ratchet wheel 20 and permitting the clock to resume its normal speed. As previously stated, when the projection 59 reaches the pin 58 the chronological position of the clock will be about 30 seconds after the 59th minute so that in speeding ahead the clock may reach this point a few seconds ahead of time to resume its normal speed thus being slightly ahead of the master clock. This will be compensated for, however, in the same manner as if the clock were fast and will be arrested at the hour position for the few seconds difference in time and will resume operation of the exact hour as previously explained.

If the clock is on time, when the magnet 39 is energized at the 59th minute as indicated by the master clock, the motor drive clock will also be at the 59th minute and the motor drive clock will speed up stepping ahead about 30 seconds until the projection 59 lifts the pin 58 as previously explained. The clock will then resume its normal speed for 30 seconds being arrested at the hour position until the master clock arrives at the hour position and then releases it.

It will be seen that if any unauthorized attempt was made to set the clock by turning the hand it could not be set forward or back in excess of an hour because the pin 64 would strike either the upper or the lower side of the projection 63 and in the following hour synchronization would be effected. For authorized setting of clocks ahead an hour for daylight saving time, a manual switch could be provided in multiple with the master clock operated contact so that the circuit to magnet 39 could be closed manually right after a synchronizing period to allow the clock to run ahead under speed until the pin 64 again struck the projection 63 at which time the magnet would be deenergized and the clock allowed to resume its normal speed. Though the clock may be out of synchronism with the master clock during the next following hour, by an amount equal to the short time in which it took the minute hands to speed ahead one hour, it will be automatically connected at the next synchronizing period. When clocks have to be set back an hour due to the same reason, a manual switch may be provided for opening the circuit to all the driving motors for an hour, thus stopping all of the clocks for that period. Such a setting of clocks is done as a group as it affects all clocks in the same manner.

In event an interruption of the current supply to the motor driving the clock through shaft 10 happens during a synchronizing period, provisions are made whereby the clocks will not be indefinitely held up due to failure of the magnets to be energized and release the blocking means. As previously stated, the pin 52 eccentrically mounted in the shaft 10 engages the teeth of the ratchet wheel 47 advancing said ratchet one tooth per revolution of shaft 10 or one tooth per minute (Fig. 6). As the ratchet wheel is advanced each time, its advance is retained by the retaining pawl 68 and as this ratchet rotates it stores power in the spring 50. From its normal starting position to the point where the pin 48 impinges against the cam 46 there are 59 teeth on the ratchet 47 which may be engaged by the pin 52 so that it requires 59 revolutions of the shaft 10, or 59 minutes for the pin 48 to travel from its position of rest to reach the cam 46. If synchronization occurs the cam is immediately released by the withdrawal of pawl 68 from the ratchet wheel when the lever 60 moves its first

step to the left and said ratchet wheel is restored by the spring 50. If, however, there has been an interruption in the current supply to the clock driving motor during the synchronizing period so that the ratchet wheel 47 was stopped prior to reaching that position and resumes operation when the current is restored after the synchronizing period has passed, there would be no operation of the magnet to release the hourly lock-up position of the movement. This condition is eliminated by the pin 48 which upon the picking up of the 60th tooth of the ratchet wheel by the pin 52 causes pin 48 to press against the cam 46 and so tilts lever 41 in the same manner as if the magnet 39 had been energized. This permits lever 60 to move to the left, as previously described, removing the pawl 88 from ratchet wheel 47 so that said ratchet wheel is restored as before.

The clock will continue operation, although slow due to the current interruption, and will be corrected at the next synchronizing period. The 61st tooth in ratchet wheel 47 is omitted as shown at 71 (Fig. 5). This is in event that if anything should break or stick the high gear ratio between the motor and shaft 10 would not cause anything to be damaged as the pin 52 could continue to rotate harmlessly and could not attempt to force the ratchet beyond the 60th tooth.

While the fundamental and novel features of the invention have been shown and described and pointed out as applied to a single modification, it will be understood that various omissions and substitute changes in form and details of the device illustrated and in its operation may be made by those skilled in the art without departure from the spirit of the invention. I intend to be limited therefor only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In a clock mechanism having a continuously rotating shaft, a time indicating device driven by said shaft whereby the time indicating device is normally advanced at a time keeping rate, the combination of an electromagnetic device controlled by a master clock, speed accelerating means controlled by the operation of said electromagnetic device in accordance with certain chronological positions of said time indicating device for advancing said time indicating device at a more rapid rate than said normal time keeping rate, means normally in blocking position for blocking advance of the time indicating device beyond a certain chronological position, and means controlled by said electromagnetic device for rendering the blocking means ineffective to permit resumption of advance of the time indicating device.

2. In a clock mechanism having a continuously rotating shaft, a time indicating device, and a gear train connecting said time indicating device with the shaft, whereby said time indicating device is normally advanced at a time keeping rate, the combination of a rotating member connected to said gear train and constantly driven at a uniform speed, a counting device operated by said rotatable member, blocking means for normally blocking advance of said time indicating device upon reaching a certain chronological position, means controlled by the counting device when it reaches a certain position of count for operating the blocking means to effect an unblocking operation of said

time indicating device whereby said device may resume its normal advance.

3. In a clock mechanism having a continuously rotating shaft, a time indicating device and a gear train connecting said time indicating device with said shaft, whereby said time indicating device is normally advanced at a time keeping rate, the combination of a rotating member connected to said gear train and constantly driven at a uniform speed, a counting device operated by said rotatable member, blocking means for normally blocking advance of said time indicating device upon reaching a certain chronological position, means controlled by the counting device when it reaches a certain position of count for operating the blocking means to effect an unblocking operation of said time indicating device whereby said device may resume its normal advance, and means controlled by the blocking means for resetting the counting device upon said unblocking operation.

4. In a clock mechanism having a continuously rotating shaft, a time indicating device, and a differential gear train connecting said shaft with said time indicating device whereby said time indicating device is normally advanced at a time keeping rate, the combination of an electromagnetic device controlled by a master clock, locking means operated by the energization of said electromagnetic device at a certain chronological position of said time indicating device for locking a part of the differential train whereby the time indicating means is advanced at a rate more rapid than said time keeping rate, means advanced concurrently and in synchronism with the advance of said time indicating means for operating said locking means to unlock the differential train when said time indicating means reaches another chronological position, and means for blocking further advance of said time indicating device upon reaching said last named chronological position, said last named means being operable upon deenergization of said electromagnet for unblocking the advance of said time indicating device to permit the resumption of the advance of said time indicating device at the normal time keeping rate.

5. In a clock mechanism having a continuously rotating shaft, a time indicating device, and a differential gear train connecting said shaft and said time indicating device whereby said time indicating device is normally advanced at a time keeping rate, the combination of an electromagnetic device controlled by a master clock, locking means controlled by said electromagnetic device and said time indicating device and operable only in accordance with the chronological position of said time indicating device for locking a part of the differential gear train whereby the time indicating device is advanced at a rate more rapid than said time keeping rate, said locking means being operable by another chronological position of the time indicating device for unlocking the locking means from the differential gear train to terminate the more rapid advance of said time indicating device.

6. A clock mechanism including a constantly driven shaft, a time indicating device normally advanced thereby at a certain speed, means for periodically advancing said time indicating device at a speed greater than said certain speed when the time indicating device is behind standard time to advance it to a certain chronological position of said time indicating device, means controlled by said constantly driven shaft upon

the time indicating device reaching said certain chronological position for rendering said speed advancing means ineffective, mechanism normally in blocking position for blocking advance
5 of said time indicating device beyond said certain chronological position in advance of standard time, means for unblocking advance of said time indicating device when correct standard time agrees with said time indicating device, and an
10 electromagnet controlled by a master clock for controlling the operation of said speed advancing means and said unblocking means.

7. A clock mechanism including a time indicating device normally advanced at a certain
15 speed, a standard time controlled element for

periodically controlling the advance of the time indicating device at a speed greater than said certain speed when the time indicating device is behind standard time to cause the advance of said device at said greater speed to a certain chrono- 5 logical position of said time indicating device, mechanism normally in blocking position for blocking the advance of said time indicating mechanism beyond said certain chronological position in advance of standard time, and means 10 controlled by said same element for unblocking the advance of said time indicating device whereby said device may resume advance at its normal speed.

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