Sept. 21, 1937. E. A. FALLER 2,093,553

SYNCHRONIZING CLOCK

Filed Dec. 21, 1935 2 Sheets-Sheet 1

FIG.1.

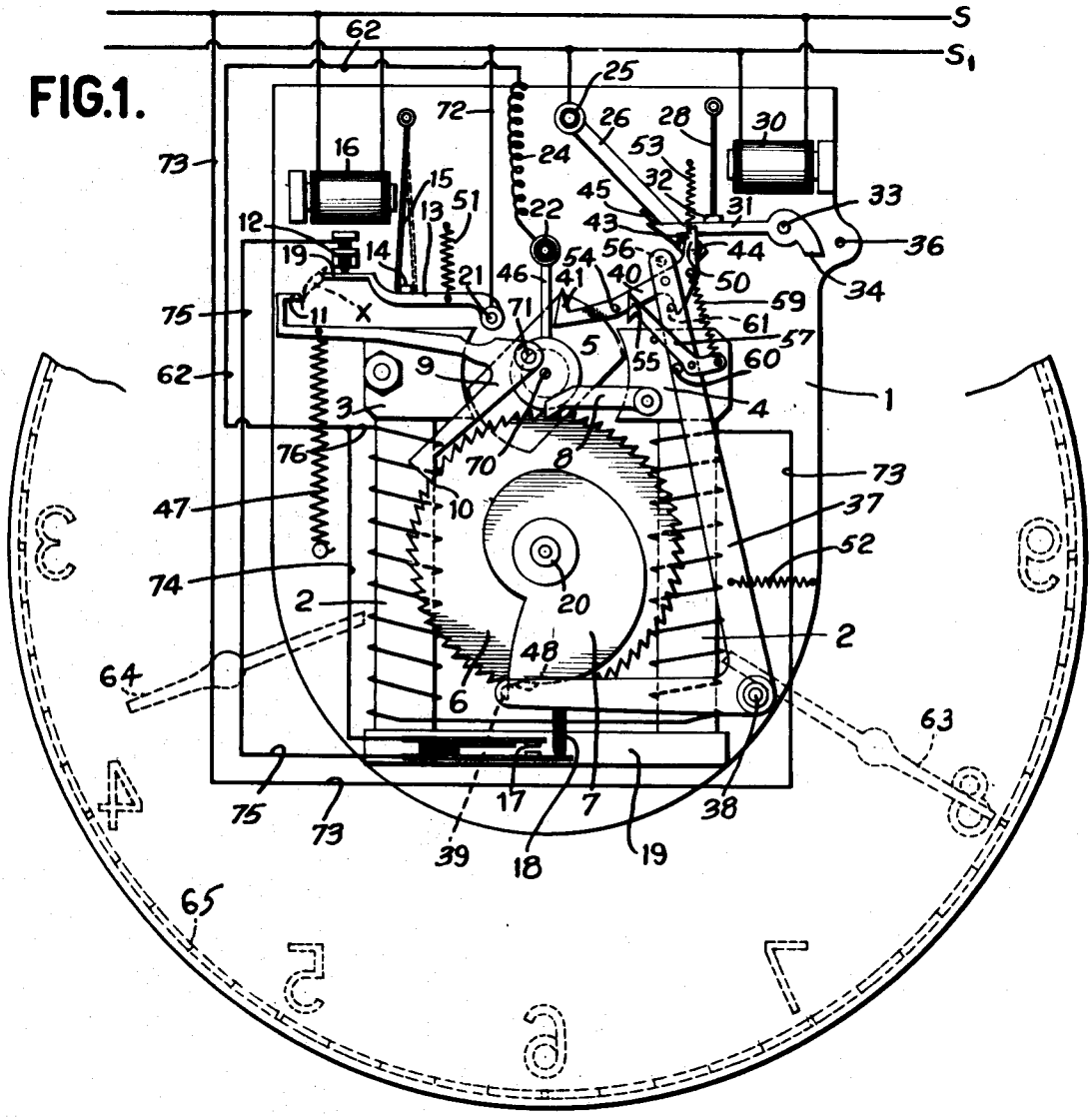

FIG.2.

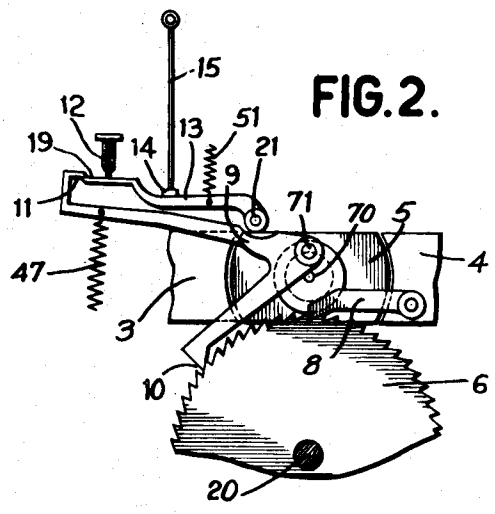

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FIG. 3.

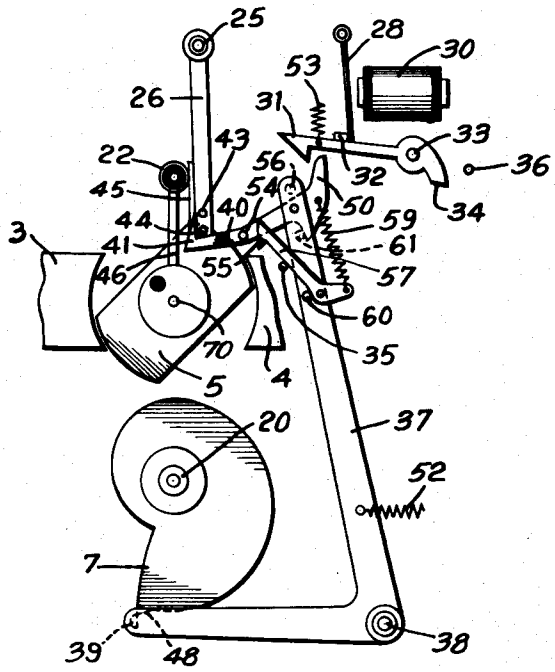


FIG. 4.

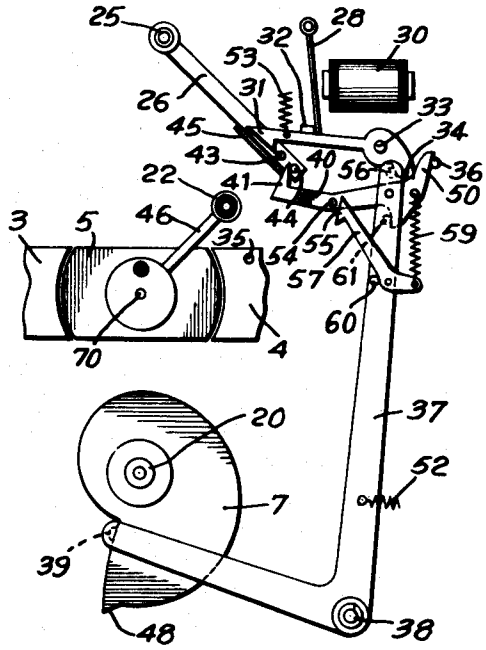


FIG. 5.

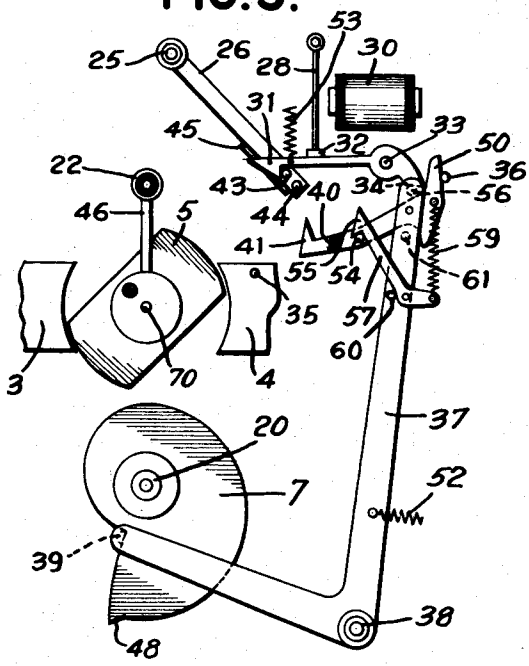
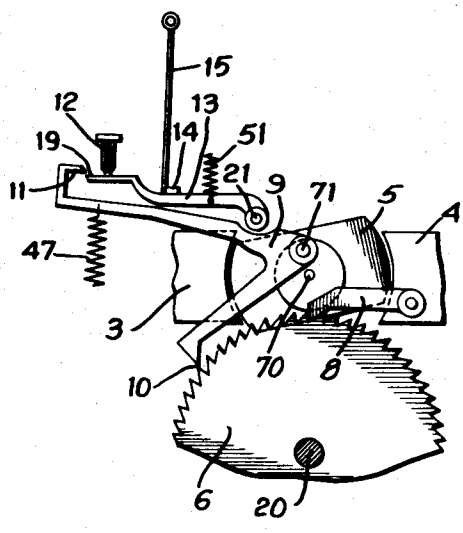


FIG. 6.



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SYNCHRONIZING CLOCK

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Application December 21, 1935, Serial No. 55,513

6 Claims. (Cl. 58—26)

This invention relates to electrically operated clocks and more particularly to clocks which are propelled periodically by electric impulses and which are periodically synchronized by a master clock.

Ordinarily clocks of this type are controlled by a master clock which initiates impulses periodically over circuits intended solely for the clock system. Such a system for example is shown in the patent to J. W. Bryce, No. 1,687,491, dated October 16, 1928. The present invention relates more particularly to clocks which may be connected to and utilize existing networks of light and power wires thereby eliminating the expense of installing and maintaining a separate and independent network of circuits for the clock system.

The present invention contemplates the superimposing of current impulses of relative high frequencies compared to normal commercial frequencies, over the light and power networks carrying current of normal commercial frequencies. Such means for transmitting said frequencies is fully and completely set forth and described in copending application of L. S. Harrison, Serial No. 17,245, filed April 19, 1935.

The present invention therefore has for its object the provision of a secondary clock mechanism which may be connected to a power and light network carrying current of commercial frequencies, the operation of which may be unaffected by said frequencies, and which may be driven by current impulses of a frequency relatively higher than the commercial frequency.

Another object of the invention is to provide a secondary clock mechanism which may be periodically synchronized by current impulses of two different frequencies.

A still further object is to provide a secondary clock mechanism which may be connected to a light or power network carrying commercial frequencies and which may utilize said commercial frequencies for power to drive said secondary under the control of current impulses of a frequency different from the frequency utilized to drive the secondary.

A still further object is to provide a secondary clock mechanism driven by a current of commercial frequency and controlled by frequency responding devices affected only by currents of frequencies different than the commercial current frequency.

Various other objects and advantages of my invention will be obvious from the following particular description of one form of mechanism embodying the invention or from an inspection of the accompanying drawings; and the invention also constitutes certain new and novel features of the construction and combination of parts hereinafter set forth and claimed.

In the drawings:

Fig. 1 shows a rear elevation of the clock mechanism with the rear supporting plate removed.

Figs. 2, 3, 4, 5 and 6 show detailed position views of parts of the mechanism.

A rigid base plate 1 may be provided to carry the various parts of the movement having a supporting frame (not shown) spaced in front of it and securely held by suitable pillars so that the two plates may act as journals for the various rotating shafts. Such construction is old and almost universally used and its elimination from the present illustration merely serves to lessen confusion. In general, two such parallelly spaced plates will be referred to as the supporting frame of the movement.

Two poles of a magnet 2 are mounted on a yoke 10 which is secured to the supporting frame. The poles terminate in shoes 3 and 4 having arcuate pole faces between which is mounted an armature 5 fixed to a shaft 70 journaled in the supporting frame. Pivotally mounted on said armature at 71 and eccentric to the center of rotation of the armature is an actuating pawl 9 which cooperates at 10 with the teeth of a ratchet wheel 6. The pawl 9 is urged in a counterclockwise direction by a spring 47. A retaining pawl 8 pivoted to the frame of the mechanism also cooperates with said ratchet wheel 6 to prevent retrograde movement. The armature 5 is normally urged in a counterclockwise direction by a suitable spring against a suitable limit stop, neither of which are shown. Such details and construction are well known in the art and are fully illustrated and described in U. S. Patent No. 1,821,100 to C. E. Larrabee, dated September 1, 1931, so that deletion of such details which play no part in the present invention will better serve to lessen confusion.

The ratchet wheel 6 is fixed to a shaft 28 journaled in the supporting frame and extending beyond the front plate to support a minute hand 63 mounted thereon. The hour hand 64 is mounted in the usual well known manner on a bushing concentric with shaft 28 and driven by the usual reduction gearing or "dial works" to operate in conjunction with the hour hand, as shown in the above mentioned patent to Larrabee. A dial 65 is suitably mounted adjacent the hands in order that the hands may properly indicate the time. The ratchet wheel 6 is provided with 60 teeth so spaced in relation to the pawl 9 that upon each oscillation of the armature 5 the pawl 9 will pick up one tooth of the ratchet wheel, thus requiring 60 oscillations of armature 5 to rotate ratchet wheel 6 through one revolution. With electric impulses transmitted to the magnets 2 at 1 minute intervals, the minute hand will normally make one complete revolution in one hour. The armature 5 is designed to rotate each time the magnets 2 are energized so that the

armature will lie with its long parallel sides, parallel with the lines of flux flowing between the pole faces. This magnet is adapted to be energized once each minute in the present embodiment so that the ratchet 6 will make one revolution per hour. Fixed to shaft 20 is a cam 7 which also makes one revolution per hour.

The pawl 9 is provided with an arm terminating in a hooked end 11 which is adapted to cooperate with the end 19 of a contact arm 13 pivoted at 21 and urged in a clockwise direction by a spring 51. The contact arm 13 is provided with a projection 14 which normally abuts the end of a tuned reed 15 as shown in Fig. 2. An adjustable point 12 is suitably mounted above and in the orbit of movement of the contact arm 13 and is so positioned that when the reed 15 is moved aside from the projection 14 the end of contact arm 13 will rest against the contact point as shown in Fig. 1. A suitable magnet coil 16 is provided adjacent to said reed and is so located that the magnetic field induced by the passage of a high frequency current through said coil will influence the reed 15. This reed being tuned to a fixed frequency will only respond when a current of like frequency is passed through the coil. When this occurs the reed is caused to vibrate and so be displaced from the projection 14 to permit contact of the contact arm 13 and contact point 12 (Figs. 1 and 6).

Pivoted at 38 and urged in a clockwise direction by spring 52 is a bell crank 37, one arm of which is provided with a cam wiper 39 resting on the edge of the cam 7. The other arm of said bell crank carries two latches pivotally mounted on opposite sides of the arm. These latches are designated by reference numerals 40 and 57 and they are spring urged by a spring 59 attached between them so that the latch 40 is urged in a clockwise direction and the latch 57 is urged in a counterclockwise direction. A pin 60 on the arm acts as a limit stop for latch 57 and a pin 61 likewise fixed on the opposite side of the arm acts as a limit stop for the latch 40. The latch 40 is offset at its end so that the hook lies in the orbit of a pin 44 which projects from the end of a pendulous member 26 and is adapted to engage the pin under circumstances to be later described.

The pendulum 26 is pivotally mounted at 25 and is provided with a contact plate 45. A contact member 22 is rigidly mounted on a vertical support 46 which is fixed by means of a bushing to the shaft 10 and oscillates in unison with the armature 5. The orbit of the contact member 22 is in the same plane with and intercepts the orbit of the contact plate 45 on pendulum 26. Latch 40 is provided with a pin 54 fixed thereto which extends into the plane of the latch 57 and is adapted to be engaged by said latch to hold the latch 40 in inoperative position at certain times.

The pendulum 26 is provided with a pin 43 fixed thereto which is adapted to be engaged by a latch 31 pivotally mounted at 33 and urged in a clockwise direction by a spring 53. The limit of rotation of the latch 31, in its urged direction, is fixed by the tuned reed 28 which normally bears against a projection 32 mounted on the latch 31 (Fig. 1). When the reed is urged to one side of the projection the latch 31 may move slightly in a clockwise direction until the end of the reed bears against the body of the latch 31 as shown in Fig. 4. An electromagnet 30 is suitably mounted adjacent said reed in a position where the flux vibrations induced by currents of different frequencies may influence it. The reed, being tuned to a certain frequency will only respond to flux vibrations from current of the same frequency characteristics.

A pin 56 is fixed to the vertical arm of bell crank 37 and projects into the plane of the latch 31 and is adapted to hit the tail projection 34 of said latch when the arm 37 is moved to the right to positively restore the reed 28 after it has been displaced by the proper current impulse.

A pin 36 is mounted in the plate 1 and is adapted to cooperate with the tail extension 50 of latch 40 when said latch is moved to the right to unlatch said latch 40 from the pin 44 and to latch it by means of pin 54 being restored to its latched position under the hook 55 of latch 57.

Mounted to the supporting frame of the movement and insulated therefrom is a normally closed contact 17. Said contact is mounted below and in the plane of the lower arm of bell crank 37. An insulated member 18 is fixed to said lower arm and projects downwardly adjacent the extended lower contact spring of the contact 17. When the arm of bell crank 37 is held with the cam wiper 39 bearing on the tip end of cam 7 as shown in Fig. 1, the insulated member 18 presses against the lower contact spring to open contacts 17.

Operation

In describing the operation it will be assumed that frequencies of 1200 and 1800 cycles will be superimposed on the light or power network carrying a standard commercial current as, for example, 110 volts 60 cycles. Lines S—S1, represent the network lines normally carrying the 60 cycle frequency current. A suitable master clock control such as is shown in the copending application of L. S. Harrison, Serial No. 18,155, filed April 25, 1935, may be provided.

Suffice it to say that means are provided for transmitting each minute over the network an impulse of a 1200 cycle frequency and in addition to transmit a series of rapid impulses of 1200 cycle frequencies starting at 59 minutes and 10 seconds after the hour and terminate at 59 minutes and 45 seconds after the hour. The rapid impulses may be transmitted at the rate of one impulse every two seconds so that during the interval from the starting to the termination of said rapid impulses a total of seventeen 1200 cycle frequency impulses will be transmitted over the network. One impulse of 1800 cycle frequency will be transmitted over the network on the even hour or 60th minute.

The tuned reed 15 will be tuned to respond to a current of a 1200 cycle frequency only passing through the coil 16 and the tuned reed 28 will be tuned to respond to a current of an 1800 cycle frequency only passing through the coil 30.

As the minute impulse of 1200 cycles is transmitted over the network coil 16 will cause the reed 15 to vibrate at each impulse and will accordingly cause said reed to be deflected to one side of the projection 14 permitting the contact arm 13 to be pulled upwardly against the contact point 12. A circuit is then closed from one side of the network S1 through wire 72, contact arm 13, contact point 12, wire 75, contact 17 (normally closed) wire 74, wire 76, through winding of magnet 2, wire 73, to the other side of the network S. The magnets 2 are now energized by the 60 cycle current normally carried by the network and the armature is rotated clockwise, passing through the position shown in Fig. 6 in which pawl 9 is pulled up the incline of its ad-

jacent tooth and upon reaching the apex 10 of said tooth the end of pawl 11 will be above the end 19 of the contact arm 13. As the armature 5 continues to rotate to reach its final position shown in Fig. 2, the pawl drops from the point 10 while continuing its movement to the right and the end 11 catches the end 19 of contact arm 13 and pulls it away from contact point 12 thus breaking the circuit to the magnet 2. The movement of the end 11 of pawl 9 in making its complete cycle follows an orbit indicated in dotted lines by reference character X in Fig. 1.

The high frequency impulse is very short and is terminated before the magnet coil 2 has had time to build up its field so that by the time the circuit is broken at contact point 12 the high frequency impulse has terminated. When the end 11 of pawl 9 depresses the contact arm 13 it lowers the projection 14 below the end of the reed 15 so that the reed returns to normal position blocking the return of the contact arm against the contact point. When the circuit is broken at contact 12 the armature quickly returns to its normal position shown in Fig. 1 moving the pawl 9 to the left rotating the ratchet wheel 6 and permitting the end 11 to slide off of the end 19 of the contact arm.

The cam 7 is provided with a projection 48 at the tip of its high point and said cam is so positioned on the minute hand shaft 20 that at the 59th minute chronological position of the secondary clock said projection is bearing against the cam follower 39 depressing the horizontal arm of bell crank 37 to its lowest position at which time it opens contacts 17 breaking the circuit between contact point 12 and the magnets 2. If the secondary clock is on time it will be standing at its 59th minute chronological position when the rapid impulses are transmitted starting 10 seconds after that time and the clock will not be affected by said impulses due to the contact 17 being open. If the secondary is slow and has not reached its 59th minute position the contact 17 will be closed and the rapid impulses will move the clock forward a distance equivalent to one minute for each impulse until it reaches its 59th minute when contact 17 opens to break the circuit and prevent further advancement. Thus each clock only utilizes as many of the rapid impulses as necessary to bring it up to time.

In the present embodiment the timing of the rapid impulses is such that only 17 are transmitted each hour but this is deemed sufficient to cover any losses that might occur in an hour's time. It is evident that the tuning could be arranged to increase the number of impulses if desired.

If the secondary clocks are fast they will reach their 59th minute chronological position before the true time and as the contact 17 will open at that time subsequent minute impulses will not affect it so that the secondary will be halted at this position until the true time of 59 minutes after the hour as indicated by the master equipment controlling the impulses. It will be seen from the foregoing that means have been provided to bring all such secondary clocks into unison at their 59th minute chronological position with all clocks having their respective contacts 17 open breaking the circuit between the contact point 12 and the magnets 2.

It is now essential to provide means to further energize the magnets 2 through another circuit to advance the clock when the even hour arrives and to re-establish the previous conditions of operation for the next following hour. To accomplish this an impulse of an 1800 cycle frequency is transmitted by the master control at the even hour. The tuned reed 28 which is tuned to respond to the magnetic flux induced by this frequency is influenced by the coil 30 when energized by the 1800 cycle impulse, and is deflected to one side of the projection 32 permitting the latch 31 to be rocked clockwise by spring 53.

The latch 31 normally engages the pin 43 holding the pendulum 26 to the right as shown in Fig. 5. When said latch is now moved clockwise it releases the pendulum 26 which swings downwardly against contact element 22 making a contact between its contact plate 45 and said element.

The latch 40 is normally held in inoperative relationship with the pendulum 26 by the latch 57 engaging the pin 54 as shown in Fig. 5. As the cam 7 turns counterclockwise the vertical arm of bell crank 37 moves to the left and when the cam follower 38 is finally lifted by the projection 48 at the 59th minute position of the secondary, the latch 57 impinges against the pin 35 and is moved clockwise disengaging pin 54 and permitting the latch 40 to be moved clockwise by spring 59 until it is halted by its limit stop 61. This throws the hooked end 41 into the path of the orbit of pin 44 on the pendulum 26 but the hook is moved at this time sufficiently far to the left so that it will not obstruct the swing of the pendulum before it strikes contact 22.

With the pendulum 26 now released and making contact with contact 22 a circuit is completed from one side of the network S_1 to the pivot 25, pendulum 26, contact plate 45, contact 22, flexible lead wire 24, wire 62, magnets 2, wire 73 to the other side of the network S. This circuit permits the 110 volt 60 cycle current to flow through the magnet 2 and when its field is built up the armature 5 oscillates quickly in a clockwise direction in the usual manner. As the armature oscillates about its axis the contact 22 also oscillates about the same axis.

The movement of the contact 22 throws the pendulum to the right and its momentum carries it away from the contact 22 when the armature reaches its limit of travel. This breaks the circuit to the magnets 2 and the armature immediately starts its return oscillation to normal position before the pendulum overcomes its momentum and starts its return swing.

As the armature returns the pawl 9 starts to rotate ratchet 6 in the usual manner and therefore the cam 7 which immediately causes the cam follower 39 to drop from the projection 48 and the bell crank 37 is pulled clockwise by the spring 52. The latch 40, now with the hook 41 in the orbit of the pin 43, moves to the right and catches the pin 43 as the pendulum 26 is making its return swing. As the cam follower 39 drops to the low point of the cam, the latch 40 carries the pendulum 26 to the right, (Fig. 4). As the bell crank 37 reaches the end of its travel the pin 43 on the pendulum 26 is carried to the right of the hooked end of latch 31 and the pin 56 on the bell crank arm strikes the tail projection 34 turning the latch 31 counterclockwise to engage pin 43 on the pendulum and to drop the projection 32 below the end of reed 28 so that the reed will return to normal position and lock the latch 31 in its holding position as shown in Fig. 5. At the same time the tail projection 58 of latch 40 impinges against the pin 36 rocking said latch counterclockwise to cause it to disengage the pin

44 on the pendulum and to cause the pin 54 to pass under the hook 55 to become restored in its normally latched position as shown in Fig. 5.

Thus the one impulse controlled by a different frequency moves all the clocks forward to the even hour and the rotation of the bell crank 37 causes the contact 17 to close again so that the impulse transmitted one minute after the hour and each minute thereafter to the next 59th minute may be resumed with the 1200 cycle frequency current in the manner first described.

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

What is claimed is as follows:

1. A clock mechanism including a time indicating device, electromagnetic means for advancing said device periodically energized by electric impulses of a commercial current frequency suitable for lighting and power purposes, a source of current supply of such commercial current frequency, a circuit connecting said source of supply and electromagnetic means, a normally open contact in said circuit, frequency responsive means responsive only to current impulses of a current frequency different from said commercial current frequency, means controlled by said frequency responsive means for closing said normally open contact whereby said electromagnetic means may become energized, and means responsive to the energization of said electromagnetic means for restoring said contact to its normally opened position whereby said electromagnetic means may become deenergized.

2. A clock mechanism including a time indicating device, an electromagnet energized by electric impulses of a certain current frequency, a source of supply for supplying said current, an armature operable upon energization of said electromagnet, a pawl operated by said armature for advancing the time indicating device, a circuit connecting said source of supply and said electromagnet, normally open contacts in said circuit, means controlled by current impulses of a different current frequency for closing said contacts whereby said electromagnet may become energized, and means controlled by the movement of said pawl upon operation of the armature for restoring said contacts to their normally open position whereby said electromagnet may be deenergized.

3. A clock mechanism including a time indicating device, electromagnetic means energized by electric impulses of a certain current frequency, a source of supply for supplying said current of certain frequency, a circuit for connecting said source of supply with said electromagnetic means, normally open contacts and normally closed contacts in series in said circuit, frequency responsive means periodically operated by an impulse of a different current frequency for periodically closing said normally open contacts whereby the electromagnetic means may become energized, and means operated by said electromagnetic means upon energization for restoring said contacts to their normally opened position and means controlled by the chronological position of the time indicating device for opening said normally closed contacts whereby energization of said electromagnetic means is rendered ineffective by the closure of said normally open contacts.

4. A clock mechanism including a time indicating device, electromagnetic means for advancing said device, a source of current supply for supplying current of one frequency for energizing said electromagnetic means, a normally open circuit connecting said electromagnetic means with said source of current supply, frequency controlled means operable only by current of a second frequency for periodically closing said normally open circuit whereby said electromagnetic means may be energized, normally closed contacts in said circuit, means controlled by the chronological position of said time indicating device for opening said contacts to prevent energization of said electromagnetic means by said last mentioned frequency controlled device, a second normally open circuit connecting said electromagnetic means with said source of current supply, frequency controlled means operable by a current of a third frequency for closing said second circuit whereby said electromagnetic means may become energized, and means operable upon energization of said electromagnetic means for opening said second circuit whereby said electromagnetic means may become deenergized to advance said time indicating device.

5. A clock mechanism including an electromagnet, a source of current supply for energizing said magnet, an armature operable on energization of said electromagnet, a circuit connecting said source of supply and said electromagnet, a normally open contact in said circuit, comprising a pendulous contact member normally latched in an open position, a second contact mounted on said armature and movable therewith, means for unlatching said pendulous member whereby it may swing against said second contact to close said circuit and energize said electromagnet, means operable by operation of said armature to swing said pendulous contact away from said second contact to thereby open said circuit and deenergize the electromagnet, and means operable on deenergization of said electromagnet for restoring said pendulous member to latched position.

6. A clock mechanism including a time indicating device, electromagnetic means for advancing said time indicating device periodically operated by electric impulses of a certain current frequency, a second electromagnetic means periodically operated by impulses of a second current frequency for initiating the transmission of electric impulses of said certain frequency to operate said first named electromagnetic means, means for interrupting the transmission of electric impulses of said certain current frequency by said second electromagnetic means at a certain chronological position of said time indicating device, a third electromagnetic means operable by a current of a third frequency for effecting the transmission of electric impulses of said certain frequency to the first named electromagnetic device to operate the same, and means controlled by the operation of said first named electromagnetic means for terminating the transmission of electric impulses of said certain frequency effected by the third electromagnetic means and for resuming the transmission of electric impulses of said certain frequency initiated by said second electromagnetic means.

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