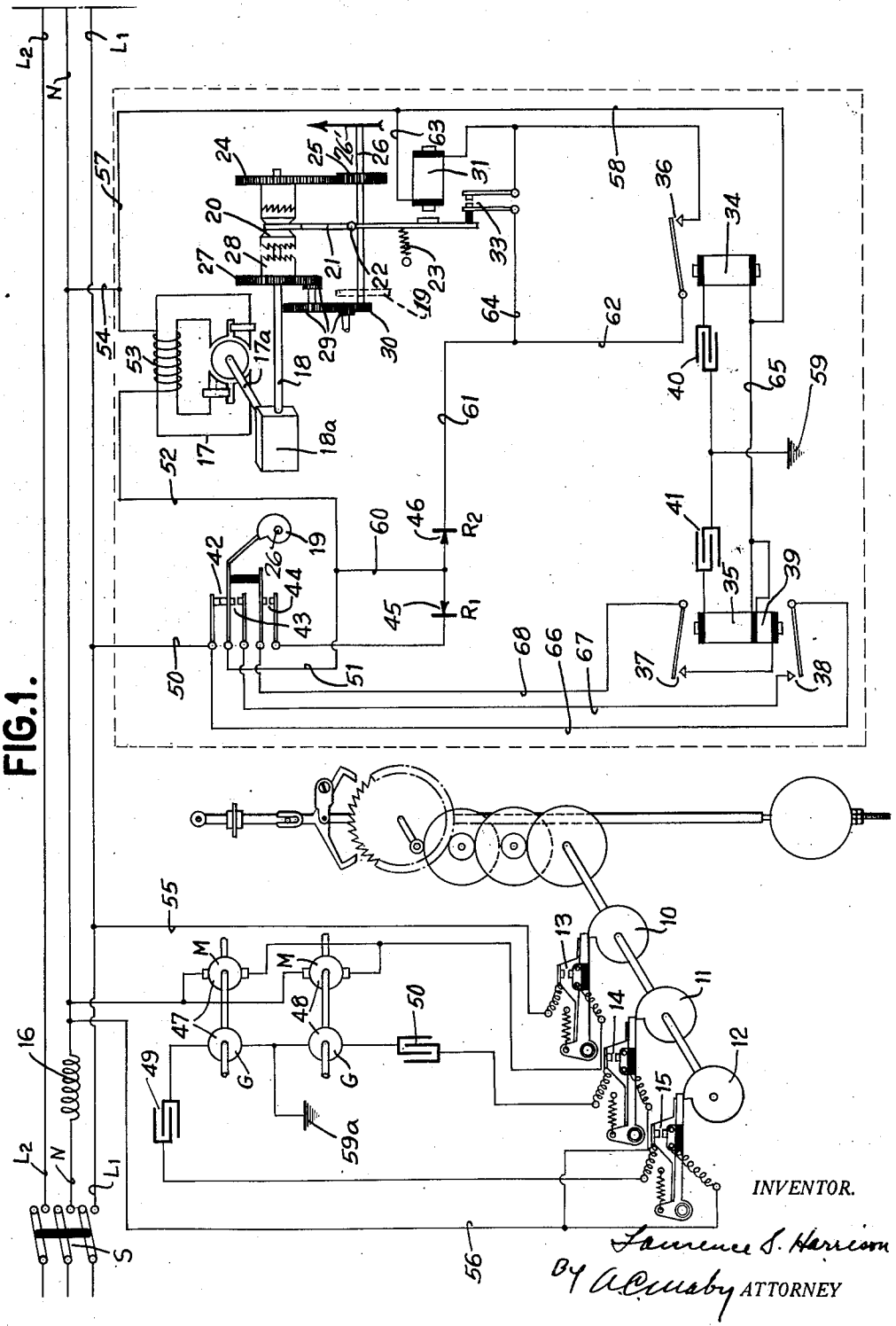
Dec. 7, 1937. L. S. HARRISON 2,101,432

TIME SYSTEM

Filed April 19, 1935 2 Sheets-Sheet 1

FIG.1.



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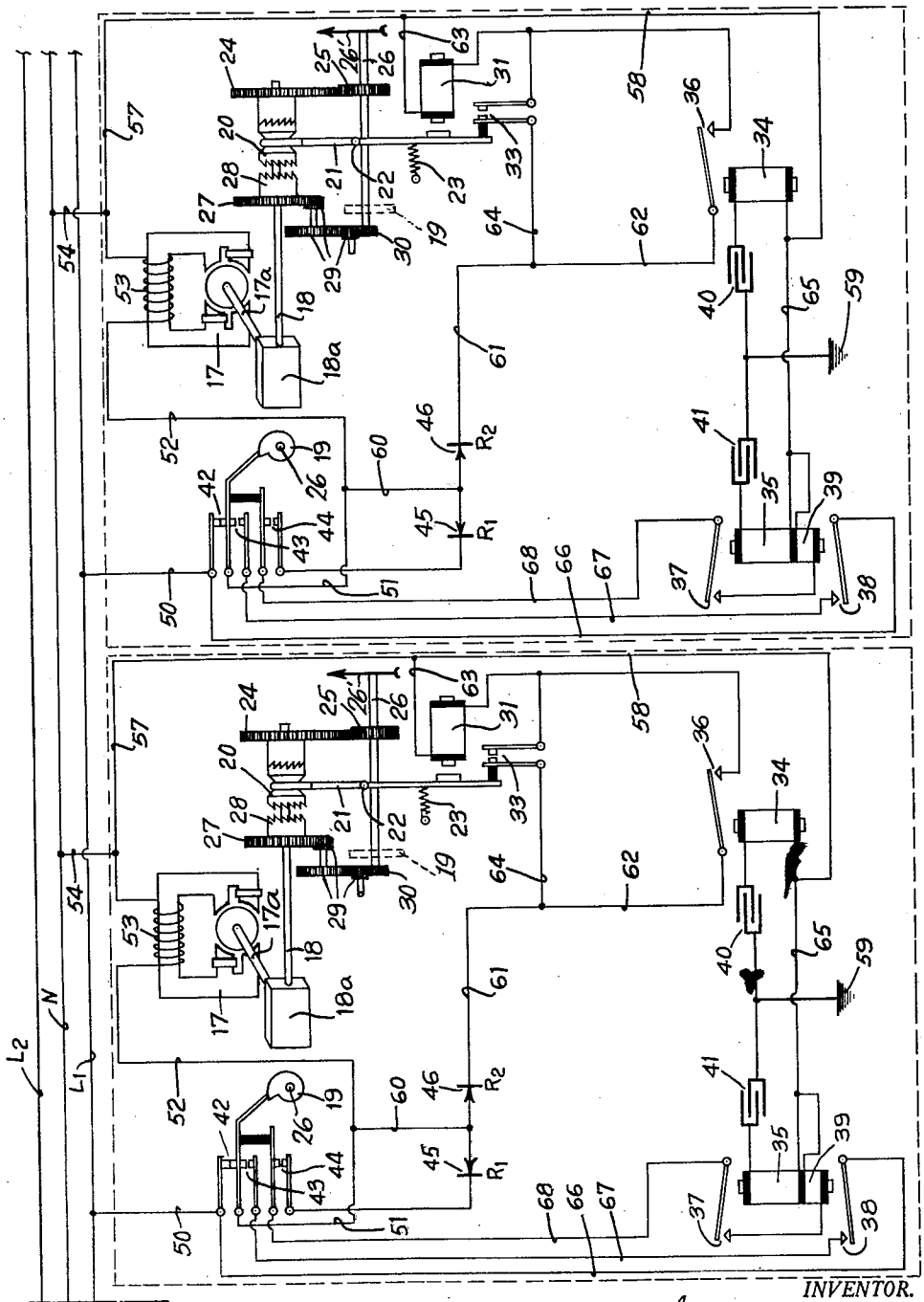


FIG. 1a.

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TIME SYSTEM

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Application April 19, 1935, Serial No. 17,245

6 Claims. (Cl. 58—24)

This invention relates to time systems in which the time indicating units are driven by synchronous or other constant speed motors running from the main lines used for distributing commercial alternating current supply. More particularly this invention relates to the periodic synchronization of such motor driven clocks by a master clock.

An object of the invention is to provide periodic synchronization of a plurality of motor driven secondaries operating from commercial power supply lines.

Another object of the invention is to provide for synchronizing a plurality of time indicating units by superimposing a frequency different from that upon which the time indicating units normally operate over the lines on which said units operate.

Still another object is to provide a master clock for initiating the transmission of a superimposed frequency over lines from which time indicating units are operating on another frequency.

A still further object is to provide for stepping time indicating units ahead faster than their normal rate by superimposing a frequency over the lines from which they operate higher than the frequency which normally operates them.

Another object is to provide for synchronizing a time indicating clock driven by a constant speed or synchronous motor with a master clock by superimposing various frequencies at timed intervals over the lines on which the time indicating clocks operate.

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:

Figs. 1 and 1*a* are a diagram of the wiring of a complete system showing diagrammatically pertinent parts of the secondary time indicating units.

The master clock in its general details may be of any desired form. For example, the master clock may be such as shown in the patents to J. W. Bryce, No. 1,390,018 and No. 1,687,491, dated September 6, 1921, and October 16, 1928, respectively. It is sufficient here to state that the master clock carries on its minute hand staff three cams 10, 11, and 12 which are fixed relatively to each other and make one revolution per hour. Such cams might correspond in their relationship to the master clock mechanism with cams 12, 13, and 15 in Patent No. 1,687,491, previously mentioned. In the applicant's embodiment the cams 10, 11, and 12 cooperate with contacts 13, 14, and 15, respectively. The cams make one revolution per hour which causes each of the contacts to open and close once during each cycle. In giving the timing of the various contacts the minutes and second of the hour will be designated. Which hour of the day it is, is of no concern since the operations occur every hour and the hour and the hour position will be designated as 60' 0'', (60th minute 0 seconds).

The operation of contact 13 is timed to close at 59' 10'' and to open at 60' 10''; that of contact 14 is to close at 60' 0'' and to open at 60' 2''; and that of contact 15 is to close at 59' 20'' and to open at 59' 22''.

In the preferred embodiment a three wire power supply distribution system is shown with the neutral wire grounded. This is a system widely used in commercial practice. It is further assumed that the three wire system is distributing 60 cycle alternating current which is the general practice in most commercial fields in the United States. In the diagram the three wire system is represented as L_1, L_2 and N. N representing the grounded neutral. A switch S may represent the connection of the power supply from the outside to a three wire system within a given area such as a building, or a single department or floor in a building. Between the outside source of supply and the distributor system to which are connected the various time indicating units comprising the clock system to be synchronized is imposed a choke coil 16 located in the neutral wire. This coil is so designed to freely pass 60 cycle alternating current but to prevent the passage of 1200 cycle and 1800 cycle frequencies which are the frequencies to be used in connection with the applicant's preferred embodiment herein disclosed.

The time indicating units which will hereinafter be called secondary clocks to differentiate them from the master clock, may be comprised of a self-starting synchronous or constant speed motor 17 of any suitable type such as are well known in the art. The rotor of said motor 17 is fixed to a shaft 17*a* which is connected through suitable reduction gearing represented by a gear housing 18*a* to a shaft 18 which rotates one revolution per hour.

Splined to shaft 18 so as to rotate therewith but freely movable longitudinally of said shaft

is a clutch element 20. This clutch element is engaged by a yoked arm 21 pivoted at 22 and biased in a clockwise direction by a spring 23 so that said clutch element normally engages and grips a gear 24 which is free to rotate about the shaft 18. The gear 24 meshes with a gear 25 which is fixed to the minute hand shaft 26 of the secondary clock to normally revolve the minute hand 26' once an hour. The usual reduction gear from the minute hand to the hour hand as well as the hour hand has been omitted in the drawings as it is old and well known in every clock and has no part in the invention or the explanation of the operation of the system. Journaled on the shaft 18 and free to rotate thereabout is a gear 27 having fixed thereto a clutch element 28 adapted to be engaged by the clutch element 20. The gear 27 meshes with a reduction gear train 29 which in turn is meshed with a gear 30 fixed to the shaft 26. The gear ratios between the gear 30 and the gear 27 is such that the gear 27 will drive the gear 30 at a speed of 60 to 1. In the normal operation of the secondary clock, gear 24 is driving gear 25 and therefore gear 30 fixed to the same shaft will drive the gear 27 idly about the shaft 18. The secondary clock is further provided with a clutch magnet 31 which, when energized, attracts its armature which is fixed to the yoke arm 21 thus causing said arm to rotate counterclockwise about its pivot 22 to disengage the clutch element 20 from the gear 24 and engage it with the gear 27 which will then drive the shaft 26 at a speed 60 times greater, as previously explained.

The gear 24 at this time will be rotated idly about the shaft 18. Cooperating with arm 21 is a contact 33, normally open, which is adapted to be closed when the magnet 31 is energized. The secondary clock is further provided with two relays having relay coils 34 and 35. Relay coil 34 when energized causes relay contacts 36 to close. Relay coil 35 when energized causes relay contacts 37 and 38 to close. The relay which is actuated by coil 35 is also provided with an additional holding coil 39. The circuit of relay magnet 34 is provided with a blocking condenser 40 to permit said coil to be energized by an alternating current of 1200 cycle frequency only and the circuit of the relay coil 35 is provided with a blocking condenser 41 to permit said coil to be energized by an alternating current of 1800 cycle frequency only. Contacts 42, 43 and 44 are provided in each secondary and are operated by cam 19 fixed to the shaft 26 so that contact 42 opens and contacts 43 and 44 close at 60' 0'' and contact 42 closes and contacts 43 and 44 open at 60' 30''. This operation occurring once each hour. Each secondary is provided with two rectifier units 45 and 46 for the purpose of supplying holding coil 39 and clutch magnet 31 with unidirectional current.

Two motor generators 47 and 48 are provided with each system generator G47 is designed to generate current at a frequency of 1200 cycles and generator G48 is designed to generate current at a frequency of 1800 cycles. The circuits from generator G47 and G48 are provided with blocking condensers 49 and 50, respectively, to block off any back circuits of 60 cycle current from the power line.

Operation

With the switch S closed so as to supply the distribution lines L_1, N. and L_2 with commercial 60 cycle current, the self-starting synchronous motor 17 operates on a circuit from L_1 through wire 50, contact 42, wires 51 and 52, field coil 53 of the motor, wire 54 to line N. Assuming now that all secondary clocks are in synchronism with the master clock and each other. At the hour position of 59' 10'' as indicated by the master clock contact 13 closes and starts motors M47 and M48 of the motor-generator sets 47 and 48. The circuit is as follows: Line L_1, wire 55, contact 13, motor M47 and M48 in parallel to line N. The generators G47 and G48 having now been started are ready to transmit 1200 cycles and 1800 cycles current, respectively, to the lines when the proper circuits are completed. At the master clock's indicated time of 59' 20'' contact 15 closes for two seconds establishing a circuit as follows: Generator G47, condenser 49, contact 15, wire 56, line N, wires 54, 57 and 58, relay magnet 34, condenser 40, ground connection 59, ground connection 59*a* to generator G47. As previously stated the choke coil 16 in the neutral line does not permit anything other than 60 cycle frequency to pass so that the higher frequencies used in the operation are confined to the system. The relay coil 35 is provided with a blocking condenser 41 as previously stated which prevents it from being effected by the 1200 cycle frequency which is now available. The relay coil 34 which is designed to operate on the 1200 cycle frequency is energized, however, closing relay contacts 36 which establishes the following circuit: Line L_1, wire 50, contact 42, wires 51 and 60, rectifier 46, wires 61 and 62, contacts 36 (now closed), clutch magnet 31, wires 63, 57, and 54, line N.

The rectified current energizes clutch magnet 31, rocking arm 21 counterclockwise and causing contacts 33 to close, thus establishing a stick circuit through clutch magnet 31 as follows: Line L_1, wire 50, contact 42, wires 51 and 60, rectifier 46, wires 61 and 64, contacts 33 (now closed) clutch magnet 31, wires 63, 57 and 54, line N. Contact 15, and consequently contact 36 is closed for only two seconds so that the stick circuit through contact 33 holds the magnet 31 energized until the speed up operation is completed.

The result of energizing magnet 31 as previously explained, is to throw clutch element 20 into engagement with gear 27 and speed up the operation of the secondary clock. When the secondary clock reaches the hour position, cam 19 causes contact 42 to open and contacts 43 and 44 to close. The opening of contact 42 breaks the circuit to the motor 17, thus stopping the secondary clock. It also breaks the circuit through clutch magnet 31, deenergizing said magnet, thus opening contact 33 and returning clutch element 20 to its normal position in engagement with gear 24. All secondary clocks have now been stepped up ahead of the master clock to the hour position, but this variation of a few seconds of time during this one period of the hour is not objectionable or noticeable in general practice.

When the master clock reaches the 60' 0'' position contacts 14 close for two seconds and establish the following circuit: Generator G48, condenser 50, contacts 14, wire 56, line N, wires 54, 57, 58 and 65, relay coil 35, condenser 41, ground connections 59 and 59*a*, to generator G48. The 1800 cycle current now being transmitted energizes magnet 35, but not magnet 34 as previously explained, causing relay contacts 37 and 28 to close and establish the motor circuit again to

start the operation of the secondary clock at the even hour (60' 0" position) as follows:

Line L_1, wires 66 and 66, contacts 38, (now closed), wire 67, contacts 43 (now closed), wires 51 and 52, motor field coil 53, wire 54, line N. Since the contact 14 is only closed for two seconds, a holding coil is brought into circuit to hold contacts 37 and 38 closed. This circuit is as follows: Line L_1, wires 50 and 68, contacts 38, wire 67, contacts 43, wires 51 and 60, rectifier 45, contact 44 (now closed), wire 68, contact 37, holding coil 39, wires 65, 58, 57 and 54, line N. The correction operation is now completed and the clocks are in synchronous operation for the ensuing hourly period at the end of which the operation is repeated. Ten seconds after the hour (60' 10") contact 13 opens and breaks the circuit to the motors of the motor-generator sets 47 and 48. At thirty seconds after the hour (60' 30") contact 42 closes and contacts 43 and 44 open thus reestablishing their original and normal positions.

The operation above described takes place every hour and it is obvious that any secondary clocks that are behind the others will have an opportunity to speed up to the hour position during the forty seconds or any part thereof that they may hold their clutch magnet energized. Each secondary as it reaches its hour position independent of the others, cuts out its own motor circuit and releases its own clutch magnet.

In the case of fast clocks, as they arrive at their hour position ahead of time, they will open contacts 42 and break their own motor circuit, holding the clock stopped on the hour position until released by the master clock.

While all the fundamental novel features of the invention as applied to a single modification have been shown, described and pointed out in the accompanying specification, it will be understood that various omissions and 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 system including a master clock and one or more synchronous motor driven secondary clocks connected to lines extending to the master clock, said lines normally carrying a low frequency current for normally advancing said secondary clocks at a time keeping rate, means for supplying high frequency currents having different frequency characteristics, to said lines, and means in said secondary clocks responsive to said high frequency currents for controlling the synchronization of said secondary clocks with respect to the master clock, said means including means responsive to a high frequency current of one frequency characteristic to periodically advance said secondary clocks which are slow with respect to the master clock at a rate of speed greater than said normal time keeping rate, means to interrupt clock advance upon a clock reaching a determined time as determined by the chronological condition of each clock, and means controlled by a high frequency current of another frequency characteristic for restarting the clocks whereby they may resume normal advance under control of the low frequency current.

2. A clock system including a master clock and one or more synchronous motor driven secondary clocks connected to lines extending to said master clock, said lines normally carrying commercial circuit of a low frequency suitable for normally advancing said secondary clocks at a time keeping rate, means for supplying high frequency currents of different frequency characteristics to said lines, said means including master clock controlled means for controlling the supply of high frequency currents to the line wherein said high frequency currents are supplied to the lines for a determined time during a certain period and are cut off from the lines during the remaining time of said period, and means in said secondary clocks responsive to said high frequency currents for controlling the synchronization of said secondary clocks with respect to the master clock, said means including means responsive to a high frequency current of one frequency characteristic to periodically advance said secondary clocks which are slow with respect to the master clock at a rate of speed greater than said normal time keeping rate, means to interrupt clock advance upon a clock reaching a determined time as determined by the chronological condition of each clock, and means controlled by a high frequency current of another frequency characteristic for restarting the clocks whereby they may resume normal advance under control of the low frequency current.

3. A clock system including a master clock and one or more synchronous motor driven secondary clocks connected to lines extending to the master clock, said lines normally carrying commercial current of a low frequency suitable for normally advancing said secondary clocks at a time keeping rate, means for supplying high frequency currents of different frequency characteristics to said lines to synchronize said clocks with respect to the master clock, and means in each secondary clock responsive to currents of different frequency characteristics for controlling the synchronization of said secondary clocks with respect to the master clock, said means including, means responsive to a high frequency current of one frequency characteristic to periodically advance the secondary clocks which are slow with respect to the master clock at a rate of speed more rapid than the normal time keeping rate, means controlled by the chronological position of each secondary clock for interrupting clock advance and simultaneously conditioning said clock for restarting and means responsive to a current of another frequency for causing said secondary clock to resume normal advance.

4. A synchronous motor driven clock normally operated from a power distributing system carrying a low frequency current for commercial power uses, means for supplying high frequency currents of different frequency characteristics to said power distribution system, synchronizing means in said clock including means controlled by a high frequency current of one frequency characteristic to accelerate the drive of the clock from the driving motor, means for stopping the synchronous motor drive of said clock when it reaches a certain chronological condition, and means controlled by a high frequency current of another frequency characteristic for resuming normal operation of said clock by the low frequency power current.

5. An electric clock system including a master clock and one or more secondary clocks, a synchronous motor in each secondary clock for driving the same, a power distribution system transmitting commercial current supply at a low fre-

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quency extending to said master clock and to which each synchronous motor is connected to advance the secondary clock associated therewith at a time keeping rate, means controlled by the master clock for supplying high frequency currents of different frequency characteristics to the power distribution system simultaneously with the low frequency commercial current, and means in each secondary clock responsive to high frequency currents of different frequency characteristics for synchronizing each secondary clock periodically with respect to the master clock, said means including means responsive to a high frequency current of one frequency characteristic for advancing said clocks which are slow with respect to the master clock at a rate faster than said time keeping rate until they reach a certain chronological position, means controlled by each secondary clock when said chronological position is reached for disconnecting the synchronous motor associated therewith from the power distribution system to interrupt advance of said secondary clock and means controlled by a high frequency current of another frequency characteristic for reconnecting said synchronous motor to the power distribution system to resume advance of said secondary clock at a time keeping rate.

6. An electric clock adapted to be controlled by currents of different frequencies including a synchronous motor operated by a current of one frequency, time indicating means, a gear train connected to said time indicating means, a clutch element driven by said motor and normally engaging said gear train to drive the time indicating means at a time keeping rate of speed, a second gear train having a gear ratio different than the first named gear train and connected to said time indicating means, means responsive to a current of a second frequency for causing said clutch element to engage said second gear train and disengage said first gear train to drive said time indicating means at a rate of speed faster than said normal time keeping rate, means controlled by the chronological position of said time indicating means for arresting the operation of said motor to interrupt the advance of said time indicating means and for causing said clutch element to disengage said second gear train and to reengage said first gear train, and means responsive to a current of a third frequency for causing said motor to resume operation from the current of the first mentioned frequency to advance the time indicating means at a time keeping rate.

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