June 24, 1930 H. E. WARREN 1,767,949

ELECTRIC CLOCK SYSTEM

Original Filed Jan. 24, 1928

Fig. 1.

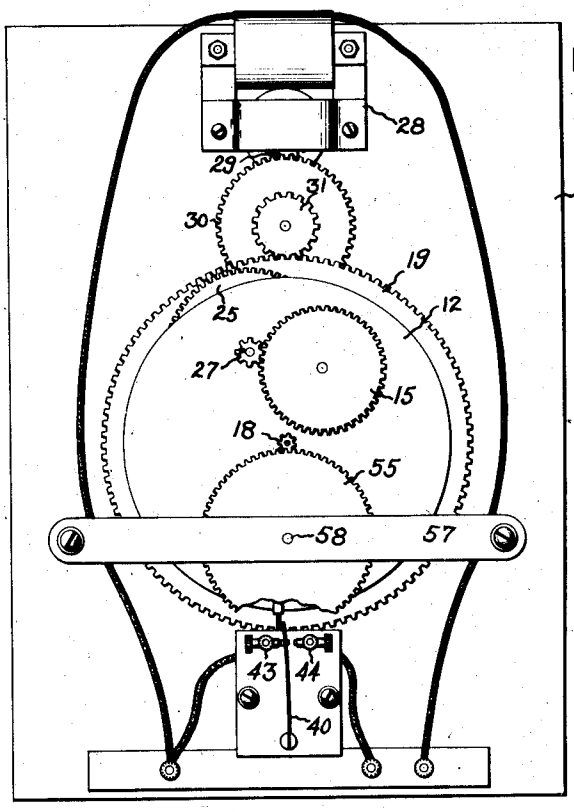
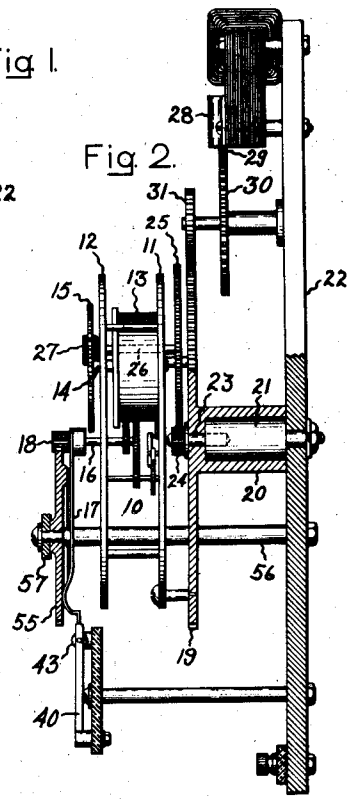


Fig. 2.



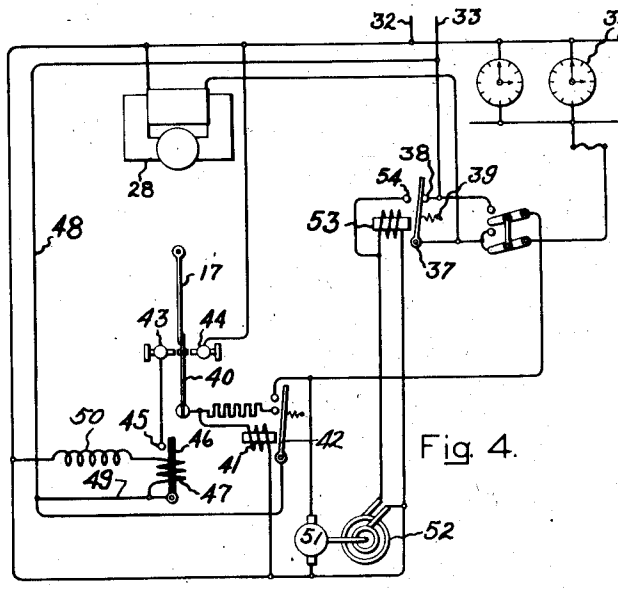
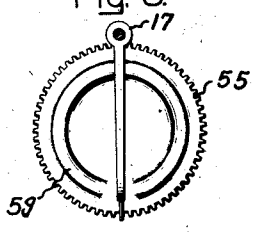


Fig. 4.

Fig. 3.



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Patented June 24, 1930 1,767,949

UNITED STATES PATENT OFFICE

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ELECTRIC CLOCK SYSTEM

Original application filed January 24, 1928, Serial No. 249,175. Divided and this application filed June 4, 1929. Serial No. 368,270.

My invention relates to electric clock systems in which one or more secondary clocks are driven by synchronous motors connected to a source of alternating current. More particularly my invention relates to an improved method and apparatus for resetting the secondary clocks after an appreciable interruption in the current supply. This application is a division of my application, Serial No. 249,175, filed January 24, 1928, assigned to the same assignee as the present invention.

In electric clock systems it is desirable that each secondary clock indicate correct time. If these clocks are driven by synchronous motors their rate is directly proportional to the frequency of the alternating current supply and the time indicated is correct only if the frequency has remained constant at the value for which the clock gearing is designed and if the current has not been interrupted.

By means of improved regulating and generating equipment it is now possible to maintain substantially constant frequency on commercial power systems. Interruptions in service, however, due to lightning, short circuits and other causes well known to those skilled in the art are practically unavoidable. It is, therefore, desirable to equip electric clock installations with means for quickly resetting the secondary clocks, as soon as current is again available, after an interruption.

The primary object of my invention is to provide simple and efficient apparatus for temporarily increasing the speed of the secondary clocks, after every appreciable interruption in service, until they again indicate correct time.

The features of my invention which are believed to be novel and patentable are set forth in the appended claims. My invention both as to its organization and method of operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings in which Figs. 1 and 2 are front and side views respectively, of the resetting device; Fig. 3 is a detail view of part 55 shown in Figs. 1 and 2; Fig. 4 is a schematic diagram of an electric clock system equipped with my resetting mechanism.

Figs. 1 and 2 show the resetting control device comprising a spring operated clock mechanism, used as a master clock or timing device, arranged to be bodily rotated by a motor, a pointer operated by the clock and a switch actuated by the pointer. Referring to these figures more in detail, 10 indicates a standard marine clock movement supported between plates 11 and 12. All details of this movement are not shown. The main driving spring is located inside of drum 13 and is wound by means of shaft 14 extending through plate 12. A gear 15 is rigidly mounted on the end of this shaft. The minute hand shaft 16 also extends through plate 12 and operates a pointer 17 and pinion 18. The clock movement 10 is mounted on a large gear 19, so that the axis of the minute shaft is in alignment with the center of the gear. On the other side of the gear 19, extending perpendicularly to it, a sleeve 20 is provided whose axis is also in line with the center of the gear. It is fitted loosely over shaft 21 which in turn is rigidly mounted on base plate 22. The entire clock movement may thus be rotated as a unit, about an axis which coincides with the axis of the minute shaft. Sleeve 20 is held in place over shaft 21 by screw 23 upon which a pinion 24 is rigidly mounted. When gear 19 rotates, a gear 25 engaging this stationary pinion 24, is rotated and drives a pinion 27 by means of shaft 26 extending through plates 11 and 12. The pinion 27 engages gear 15 and drives shaft 14, thus winding the spring. This train of gears is so proportioned that normally the spring is wound at the same rate that it unwinds, whereby it is maintained at a constant tension.

Gear 19 is arranged to be driven counterclockwise by a motor 28 through a set of reducing gears. The motor is preferably of the self-starting synchronous type such as is described in my Patents 1,283,432, 1,283,434 and 1,283,435. Motor 28 drives gear 19 at a normal rate of one revolution per hour by means of gear 29 mounted on its shaft and

engaging gear 30. Gear 30 drives a pinion 31 engaging gear 19.

Pointer 17 is operated clockwise by the master clock mechanism at the rate of one revolution per hour thus corresponding to the minute hand of a clock. During normal operation of motor 28 this pointer, therefore, remains stationary at any predetermined position. But when motor 28 stops due to an interruption in service pointer 17 will immediately move clockwise. The angular distance that it moves from its normal position is, therefore, a measure or integration of the interruption of service or of the negative frequency error and if the motors of the secondary clocks stopped at the same time, this distance is also equal or proportional to that which the minute hands of these clocks should be set ahead to indicate correct time. Therefore, in order that the position of this pointer 17 may control the resetting of the secondary clocks I cause it to actuate a switch as hereinafter described in connection with Fig. 4, and I connect the motor of this resetting device to the source from which the secondary clock motors are energized.

Fig. 4 illustrates diagrammatically an electric clock system equipped with a resetting device such as illustrated and described in connection with Figs. 1 and 2. The secondary clocks are each operated by a synchronous motor of which only the connections are indicated, which operate the clocks through a gear transmission, not shown.

Referring now in detail to this figure, 32 and 33 indicate the incoming lines from any suitable commercial source of alternating current. The secondary clocks are indicated at 34 and are connected in parallel to the buses 35 and 36. Bus 35 is connected directly to line 32 and bus 36, as well as one terminal of motor 28 are connected to line 33 through a switch 37. Switch 37 under normal conditions is biased against contact 38 by spring 39, and thereby connects motor 28 and the secondary clocks to the source 32—33. During resetting operation however, it is biased to connect the motor 28 and the secondary clock motors to a higher frequency source.

The position of the switch is determined and controlled by the resetting mechanism through pointer 17. Pointer 17 engages at its end a contact spring 40, which is electrically connected to one end of a magnet coil 41 which when energized closes a switch 42. Contact spring 40 is so mounted between two adjustable contact posts 43 and 44 that it may be forced into contact with post 44 by pointer 17, but engages contact 43 if released. Contact post 44 is connected to conductor 35, and 43 is connected to contact 45 of a thermostatic switch 46. When the installation of the resetting device is made, pointer 17 is set to force contact spring 40 in engagement with contact post 44. This position is maintained, as has already been explained, as long as motor 28 is energized and operates. As soon as motor 28 is deenergized and stops, pointer 17 will move clockwise due to the operation of the clock mechanism and thereby releases contact spring 40 which then makes contact with contact post 43. An electric circuit is thereby established from line 32 through 35 to which one end of magnet coil 41 is connected, through coil 41, spring 40, contacts 43 to contact 45 of switch 46. Switch 46 is a thermostatic element heated by a coil 47 connected to the common source. The circuit is, line 33, conductors 48 and 49, coil 47, reactance 50, conductor 35 to line 32. When coil 47 is deenergized thermostat 46 cools and flexes toward contact 45. The time that 46 takes to cool and engage contact 45 can be adjusted to any suitable value and constitutes the shortest time for which resetting is desired. The switch 46 is not essential and may be omitted in which case 43 will be connected directly to line 48. Switch 46 is employed to prevent frequent operations of the clock resetting device due to slight variations in the normal frequency supply and failures of only momentary duration. When the clock system is connected to an unregulated source it is advisable to omit this switch 46 so as to allow resetting due to frequency errors only.

When in the case of a service interruption 46 cools and engages contact 45, a circuit is established which connects magnet coil 41 to the power source. This circuit is from line 32, conductor 35, coil 41, spring 40, contacts 43 and 45, thermostat 46, conductor 49 to which it is electrically connected, to conductor 48 and line 33. When power is again available coil 41 will be energized and will close switch 42 against the action of a spring. This closing of switch 42 energizes motor 51 of the frequency converter. The circuit is line 33, conductor 48, switch 42, motor 51, conductor 35 to line 32. This motor then starts and drives generator 52. When this generator builds up its voltage, a magnet coil 53 connected across its terminals is energized and actuates switch 54. Switch 37 is a double throw switch which, when coil 53 is deenergized, is held against contact 38 by the action of spring 39, thereby causing motor 28 and the secondary clock motor to be energized from the lines 32—33. When coil 53 is energized, 37 makes contact with contact 54 which is connected to one terminal of the generator. The other terminal of the generator is permanently connected to one terminal of the clock motors and motor 28, through conductor 35. The motor 28 and the clock motors are therefore supplied by this generator during the resetting period. The frequency of this current is pref-

erably twice that of the commercial source. The clocks and gear 19 are, therefore, operated at twice normal rate until pointer 17 has again reached its normal position. When switch 42 opens, it opens the circuit to the motor of the frequency converter which stops. As soon as generator 52 stops coil 53 is deenergized, switch 37 opens and connects motor 28 and the secondary clock motors to the commercial source whereupon normal operation is resumed.

Fig. 3 shows an attachment to the resetting device shown in Figs. 1 and 2 to take care of an interruption in service lasting longer than one hour. It is evident that if power is off more than one hour the pointer 17 will have made one complete revolution and would under normal conditions engage contact spring 40 on its reverse side, thereby breaking or otherwise becoming damaged. To avoid this I provide gear 55 suitably supported on base 22 by means of studs 56, cross piece 57 and pin 58, to engage pinion 18. This gear 55 is provided with a projecting cam surface 59 comprising eleven twelfths of a complete circle, and is set so that the pointer 17 touches the gear surface at a point between the ends of this cam surface 59 when it is in its normal position. The ratio of the pinion to the gear is 1 to 12, so that when pointer 17 and pinion 18 have made one revolution, the gear 55 has made one twelfth of a revolution and has interposed cam surface 59 between itself and the pointer. As the pointer then returns to engage spring 40 it engages cam surface 59 and is thereby deflected rearwardly so as to pass contact spring 40. This same action takes place for twelve consecutive revolutions of pointer 17, if the power is off that long. After the twelfth revolution, however, the open space between the ends of the cam surface 59 is again in such position that if power were turned on at that moment the pointer would be in its normal position and no resetting would take place. If the power is off less than twelve hours and more than one, the cam surface 59 also prevents the engagement of pointer 17 with spring 40 on its return journey until the correct hour is reached.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In an electric clock system connected to a source of commercial alternating current, secondary clocks operated by synchronous motors, a second source of alternating current having a frequency greater than the first source, and means for connecting said clock system to said high frequency source to correct for the negative frequency error of the first source, including a master clock provided with a minute hand, means to rotate said master clock in synchronism with, but in opposite direction to, the secondary clock minute hand and provided with a switch controlled by said master minute hand and arranged to connect said clock system to either of said two sources.

2. An electric clock system including secondary clocks operated by synchronous motors, a resetting device including a spring operated master clock provided with a minute hand, a synchronous motor arranged to rotate said master clock in synchronism with the minute hands of said secondary clocks but in opposite direction thereto, a commercial source of alternating current, a secondary source of alternating current having a frequency higher than that of said commercial source and a switch controlled by the minute hand of said master clock arranged to connect said system to either of said two sources.

3. An electric clock system including secondary clocks operated by synchronous motors, a resetting device including a spring operated master clock provided with a minute hand, a synchronous motor arranged to rotate said master clock in synchronism with the minute hands of said secondary clocks but in opposite direction thereto, a commercial source of alternating current, a second source of alternating current having a frequency higher than that of said commercial source, a switch controlled by said master clock minute hand arranged normally to connect said system to said commercial source, and means to connect said system to said second source to eliminate the negative frequency error of said first source, and means whereby said second source operates said system only after the negative frequency error of said commercial source exceeds a predetermined value.

In witness whereof I have hereunto set my hand this 31st day of May, 1929.

HENRY E. WARREN.