July 14, 1942. G. C. ENGEL 2,289,636

CORRECTIVE CLOCK SYSTEM

Filed June 21, 1939 2 Sheets-Sheet 1

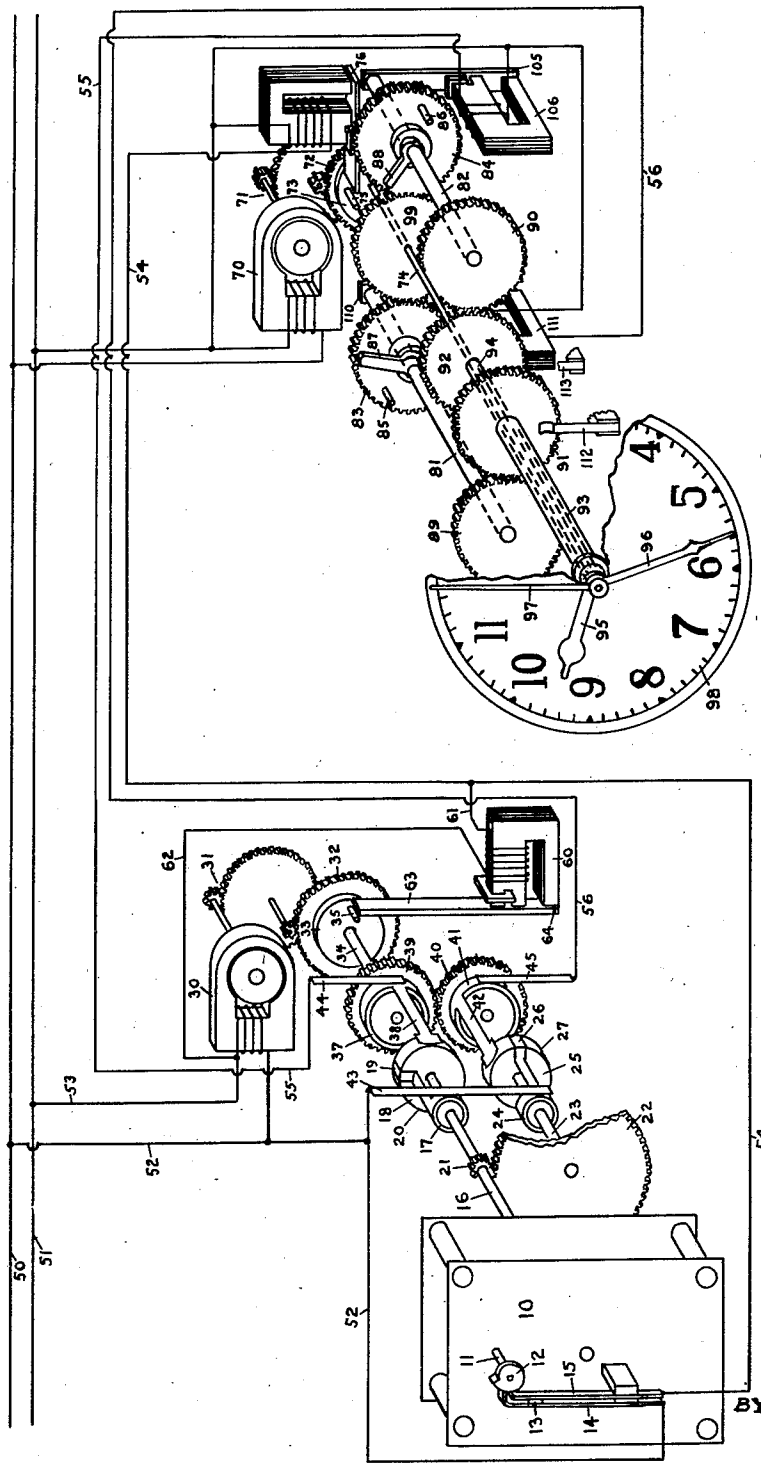


FIG. 1

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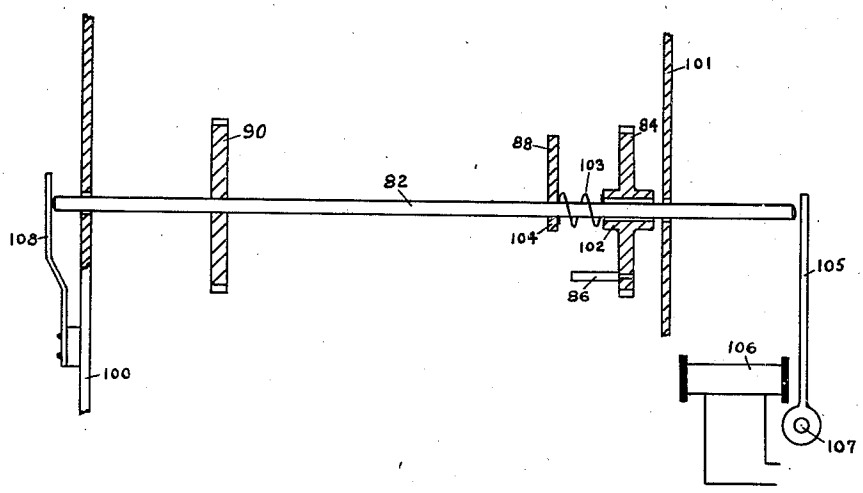


FIG. 3

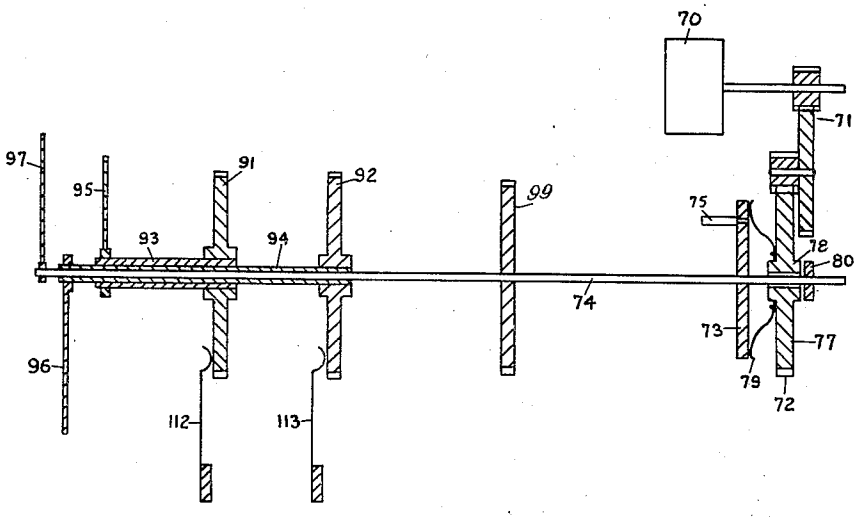


FIG. 2

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Patented July 14, 1942

2,289,636

UNITED STATES PATENT OFFICE

2,289,636

CORRECTIVE CLOCK SYSTEM

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Application June 21, 1939, Serial No. 280,245

11 Claims. (Cl. 58—35)

This invention relates to improvements in corrective clock systems.

In a number of the clock systems in commercial use at present no second hand can be provided for the secondaries for the latter are intermittently driven by means of electromagnets which are periodically energized. Furthermore, correction is effected only at predetermined intervals, and is often limited in extent. In the systems which do not possess the above limitations, correction is usually effected of the system as a whole, but correction of an individual secondary clock with respect to the system as a whole may be effected only at stated intervals, such as an hour.

This invention is directed particularly toward a clock system wherein correction is effected at intervals of approximately one minute, and which may be termed a continuously correcting clock system. Furthermore, any secondary may be corrected at any time, regardless of whether or not the system as a whole needs correction due to a current interruption, and continuous driving means are employed for each secondary so that a second hand may be provided if desired.

An object of my invention is to provide an improved corrective clock system.

A further object is to provide a continuously correcting secondary clock system.

A further object is to provide a secondary clock which may be corrected at any time independently of other secondaries in the system.

A further object is to provide a secondary clock system wherein the correction of the secondaries is not limited in extent.

A further object is to provide an improved corrective secondary clock having a second hand.

A further object is to provide an improved secondary clock which may correct itself with respect to hours, minutes, and seconds at intervals of approximately one minute.

A further object is to provide an electrically driven secondary clock wherein the power for the operation of the same may be obtained from any convenient alternating current outlet.

A further object is to provide a secondary synchronous clock system which is not dependent upon a regulated source of alternating current.

Other objects, features and advantages will be apparent as the description proceeds.

Figure 1 is a diagrammatic view of one embodiment of my invention, certain elements being shown in perspective;

Figure 2 is a sectional elevation of a portion of a secondary apparatus;

Figure 3 is a sectional elevation of another portion of a secondary apparatus.

Suitably mounted on the frame work, not shown, of the master apparatus is a master clock 10 which may be of the usual type such as a spring driven electrically wound clock. A second shaft 11 is provided with a cam 12 which is adapted to close contacts 13 once every minute, the contacts being mounted on resilient members 14 and 15, one end of each of which is bent over to form a cam following portion and the other end of each being suitably anchored on and insulated from the master clock. A minute shaft 16, that is, one which makes one revolution every hour, extends backwardly from the master clock and terminates in a slip ring 17, insulated from the shaft, and an associated commutator 18, a small portion of the commutator's periphery comprising a conducting segment 19 electrically associated with the slip ring, and the remainder of the commutator's periphery comprising an insulating segment 20.

A pinion 21 is mounted on minute shaft 16 and is adapted to drive a wheel 22 mounted on shaft 23 at the rate of one revolution every twelve hours, this latter shaft corresponding to the hour shaft of a clock. Shaft 23 also terminates in a slip ring 24 and an associated commutator 25 of similar construction to slip ring 17 and commutator 18, and of which the commutator comprises conducting segment 26 and an insulating segment 27.

A synchronous motor 30 through intermediate gearing 31 drives a clutch driving member 32 with which cooperates a clutch driven plate 33 mounted on a shaft 34 which is in end to end alignment with the minute shaft 16. Shaft 34 is adapted to be normally rotated by the synchronous motor at a rate of one revolution per minute, but a projecting pin 35 mounted on the clutch driven plate 33 is adapted to be engaged by a blocking member, armature 63, to prevent rotation of the shaft 34 under certain conditions to be described below. Shaft 34 terminates in a slip ring 37, insulated from the shaft, and on which is mounted a brush 38 for cooperation with commutator 18. A wheel 39 on shaft 34 engages a wheel 40 of an equal number of teeth which causes rotation of slip ring 41 on which is mounted a brush 42 for cooperation with commutator 25. Brush 38 rotates in the same direction as commutator 18 so that contact between the brush and segment 19 will occur at 60/59 minute intervals, provided that pin 35 is not obstructed, and brush 42, which rotates at the same speed as brush 38, and in

the same direction as the much slower rotating commutator 25, will contact segment 26 of the latter at intervals of 720/719 minutes. A brush 43 contacts each of slip rings 17 and 24, brush 44 contacts slip ring 37, and brush 45 contacts slip ring 41.

Reference numerals 50 and 51 represent the two wires of a standard 110 volt sixty cycle alternating current power line. A conductor 52 extends from wire 50 to resilient member 14, to which conductor is also connected one terminal of synchronous motor 30 and brush 43. The other terminal of the synchronous motor is connected by conductor 53 to wire 51. A conductor 54 extends from resilient member 15 to the secondary clock over which impulses are transmitted every minute to corect the position of the second hand. A conductor 55 extends from brush 44 to the secondary over which impulses are normally transmitted at 60/59 minute intervals to correct the minute hand, and conductor 56 connects brush 45 and the secondary over which conductor impulses are normally transmitted at 720/719 minute intervals to correct the hour hand.

An alternating current electromagnet 60 is connected by conductors 61 and 62 between conductors 54 and 53 so that it will be energized once every minute by the closing of contacts 13. An armature 63 is suitably pivoted at 64 and biased away from the electromagnet so that its upper end extends into the path of pin 35 to block the rotation thereof and of the brushes 38 and 42. The function of electromagnet 60 and armature 63 is to synchronize the rotation of the pin 35 with the closing of contacts 13.

A synchronous motor 70 suitably mounted on the frame work, not shown, of the secondary through intermediate gearing 71 drives a clutch driving member 72 with which cooperates a clutch driven plate 73 mounted on a shaft 74. A projecting pin 75 is mounted on the clutch driven plate 73 and is adapted to be engaged by a blocking member, armature 76, to prevent rotation of shaft 74 whereby the rotation of this shaft may be synchronized with the rotation of shaft 34 and the closing of contacts 13. The construction of the above secondary synchronizing elements is essentially the same as the construction of the corresponding master apparatus synchronizing elements, and is shown in detail in Figure 2. Clutch driving member 72 comprises a wheel 77 which is driven by intermediate gearing 71. The hub portion, 78, of wheel 77 is rotatably mounted on shaft 74. A resilient spider 79 is non-rotatably affixed to wheel 77 and bears against the face of clutch driven plate 73 in the usual manner. A collar 80 is affixed to shaft 74 to prevent axial movement of the wheel with respect to the shaft.

Shafts 81 and 82 are positioned on either side of shaft 74, and on each shaft is rotatably mounted, with respect to its respective shaft, a wheel, 83 and 84, respectively, both of which mesh with and are driven by wheel 99 affixed to shaft 74. From each wheel projects a pin, 85 and 86, respectively, each of which are adapted to engage a projection, 87 and 88, affixed to their respective shafts 81 and 82 so that the shafts may be rotated by the synchronous motor 70. Each shaft has a wheel, 89 and 90, affixed to it, wheel 90 engaging wheel 92 and driving it and the sleeve 94 to which it and minute hand 96 are affixed, and wheel 89 engaging a wheel 91 and driving it and the sleeve 93 to which the latter wheel and the hour hand 95 are affixed. A sweep second hand 97 is affixed to the outer end of shaft 74, and the three hands, 95, 96 and 97 cooperate with clock dial 98 in the usual manner. Sleeve 94 surrounds shaft 74 and extends only from wheel 92 through the dial, whereas sleeve 93 surrounds sleeve 94 and extends from wheel 91 through the dial to the hour hand.

Figure 3 shows in detail the assembly of the elements associated with shaft 82, the assembly of the elements associated with shaft 81 being substantially identical thereto. Shaft 82 is journaled in front and rear plates 100 and 101, respectively. The wheel 84 is provided with a hub or sleeve 102 which permits the shaft to slide axially thereto and which permits the wheel to rotate independently of the shaft. A coil spring 103 is positioned between collar 104, from which projection 88 extends, and hub 102 to force the other end of the hub against the rear plate at all times. Consequently, it is evident that when the shaft is displaced to the left by the operation of armature 105 that wheel 84 will remain in engagement with wheel 99, and that projection 88 will be displaced to the left so that it will be disengaged from the rotating pin 86. An electromagnet 106 is suitably positioned so as to attract the armature 105 which is pivoted at 107, the armature working against the leaf spring 108, mounted on the front plate 100, which engages the front end of shaft 82 so that the projection 88 is displaced to its disengaged position with respect to pin 86 only when the electromagnet 106 is energized. It is evident, therefore, that when the magnet is not energized, that the pin 86 which normally rotates continuously, will engage projection 88 thereby causing rotation of the minute hand until energization of the magnet causes disengagement of the pin and the projection, the time of energization determining the position of the minute hand.

An armature 110 and electromagnet, 111, are similarly provided for shaft 81, so that the time of energization of the latter magnet will determine the position of the hour hand.

Wheels 91 and 92 are provided with teeth of sufficient breadth to allow wheels 89 and 90, respectively, to always mesh therewith, whether the shafts are in displaced position or not. Friction members 112 and 113 which may be suitably mounted on the frame work of the secondary are provided to engage wheels 91 and 92 to prevent rotation thereof during times that projections 87 and 88 are not being positively driven by pins 85 and 86. It will further be noted that wheels 83, 84, 89, 90, 91, 92 and 99 are all of the same diameter and have the same number of teeth; consequently when shafts 81 and 82 and sleeves 93 and 94 rotate, they rotate at the same speed as shaft 74.

With regard to the operation of my invention it will be noted that the closing of contacts 13 synchronizes the relative positions of pins 85 and 86 of the secondary with the position of brushes 38 and 42 of the master apparatus, this being accomplished by the blocking of pins 35 and 75 by armatures 63 and 76, respectively, and the simultaneous releasing thereof. Contacts 13 are closed for a period of approximately two seconds and the armatures 63 and 76 are accordingly in their operated positions for a corresponding period. If a pin is ahead of its correct position it will be blocked by the armature, since the latter has not yet been operated, and will be held until contacts 13 are closed and the magnets

energized. If a pin is more than two seconds behind its correct position, contacts 13 will have opened and the armature will again be in its blocking position so that the pin will be held until the following synchronizing impulse is received. At a definite time after the synchronizing impulse, brush 38 will be rotated into contact with conducting segment 19 to generate an impulse which is transmitted to and actuates electromagnet 106. Inasmuch as reduction gearing 31 is equal to gearing 71, the rotating speed of pin 86 and brush 38 are equal, and the angle through which the pin 86 has moved from the time that pin 75 has been released until the energization of electromagnet 106 which disengages the driven projection 88 from pin 86 will be equal to the angle through which brush 38 has moved from the time of the release of pin 35 until contact of the brush with the conducting segment. Consequently, no matter in what position the driven projection 88 has remained during the preceding minute, it will be engaged by the pin 86 and rotated to a position corresponding to the position of the conducting segment 19 at that moment. If the position of the segment corresponds to the position of the minute hand of the master clock and the position of projection 88 to that of the secondary minute hand, it is evident that the latter will advance upon receipt of each minute corrective impulse to the position of the master clock minute hand. As the minute correcting impulses are transmitted at 60/59 minute intervals, in normal operation, pin 86 engages the driven projection 88 for only 1/59 minute and at a speed of one revolution per minute, rotates it 1/59 revolutions, or through a distance of 60/59 minutes of time as measured on the dial.

In the same manner, the position of the secondary hour hand will be corrected upon the receipt of each hour hand correcting impulse, these impulses occurring at 720/719 minute intervals, and the hour hand normally being advanced 1/719 revolution by each impulse.

If the frequency of the alternating current supply line is increased, it will make little difference in the time keeping qualities of the secondary, for the driving means for the brushes 38 and 42 and the pins 35 and 86 are synchronized to rotate with each other at an average speed of one revolution per minute, and their actual speed is immaterial if phase synchronism is maintained. If the frequency of the alternating current line drops materially the pins 35 and 75 may be blocked during alternate minutes, but phase synchronism between the two will still be maintained.

If desired, the intermediate gearing may be such that the speed of the pins 35 and 75 will be increased so that normally they will be blocked during each revolution. With the present arrangement, blocking occurs only when the pins run fast, or when the accumulated slow error exceeds the length of the synchronizing impulse. Furthermore, the synchronizing impulses may occur at 60/61 minute intervals and the minute hand correcting impulses at one minute intervals so that the minute hand will be advanced on the minute, rather than on the fractional minute intervals as described herein. If the latter alternative is employed, the sweep second hand arbor will be separate from and rotate at a different speed than the shaft 74 on which clutch driven plate 73 is mounted. Any suitable cam actuated contacting means may be employed to generate the impulses at the desired intervals, but the commutator and brush arrangement herein shown is preferred for the ease with which it permits the master clock to be manually set either forward or backward.

It will be noted that the herein described system is a three wire system, that is, three separate conductors are employed to transmit the three types of impulses to the secondaries, in addition to the usual alternating current lines which furnish power for driving the synchronous motor in each secondary and which provide a common return conductor from the secondaries to the master apparatus. Although this clock system has been disclosed in combination with alternating current electromagnets, direct current or rectified current electromagnets may be used.

Various other modifications and changes in the timing, in the circuits and wiring, and in the apparatus above described, as well as changes in the sizes and proportions of the parts thereof, which will occur to those skilled in the art, may be effected without departing from the spirit of my invention, as defined by the following claims, and all statements regarding the operation of my invention are intended to be illustrative only and not limitations on the said claims.

I claim:

1. A secondary clock system comprising master apparatus and a plurality of secondary apparatus, a minute shaft for said master apparatus, a commutator associated with said minute shaft, a minute indicating hand associated with each of said secondary apparatus, a rotatable brush associated with said commutator, synchronous driving means for said rotatable brush and for said minute indicating hand in each of said secondaries, electromagnetic means including a clutch to disengage said minute indicating hand in each of said secondaries from said synchronous driving means, and a circuit between said master apparatus and said secondary apparatus including said commutator and said brush and said electromagnetic means in each of said secondaries.

2. A secondary clock system comprising master apparatus and secondary apparatus, time responsive driving means associated with said master apparatus, synchronizing contacts actuated by said driving means, minute hand positioning contacts actuated by said driving means, a synchronous electric motor associated with said secondary, a minute hand driving element driven thereby, a minute hand, a rotatable member associated with said minute hand, clutch means for interconnecting said rotatable member and said minute hand driving element, a first circuit including said synchronizing contacts, electromagnetic means in said circuit for controlling the average speed of rotation of said minute hand driving element, a second circuit including said minute hand positioning contacts, and electromagnetic means in said second circuit for releasing said clutch means at predetermined times whereby the position of said minute hand is determined by the time interval between actuation of said second contacts and said minute hand positioning contacts.

3. The secondary clock system comprising master apparatus and secondary apparatus and circuits connecting the two, said master apparatus including time responsive driving means, contact apparatus driven by said driving means

for the generation of two sets of impulses to be transmitted over said circuits at regular intervals, the frequency of one set of impulses differing from the frequency of the other set of impulses by one impulse per hour, and said secondary apparatus including a control element, synchronizing means actuated by that set of impulses having the higher frequency for synchronizing said control element with said time responsive driving means, and minute hand positioning means actuated by said control element and by that set of impulses having the lower frequency.

4. A secondary clock system comprising master apparatus and secondary apparatus, a plurality of circuits interconnecting said apparatus, a rotatable minute hand for said secondary apparatus, hand positioning means for said secondary apparatus, driving means for said hand positioning means, a slip connection between said driving means and said hand positioning means, means for blocking the rotation of said hand positioning means beyond a given position, means associated with said master apparatus for transmitting synchronizing impulses at regular intervals over one of said circuits for releasing said hand positioning means, means associated with said master apparatus for transmitting hand positioning impulses over another of said circuits at regular intervals, and means associated with said secondary apparatus responsive to the receipt of hand positioning impulses for disengaging said minute hand from said hand positioning means, the relative angular position between said hand positioning means and said minute hand being identical at the time of said disengagement whereby the position of said hand positioning means at the time of said disengagement with respect to said given position is determined by the time interval between said synchronizing impulse and said hand positioning impulse.

5. A secondary clock system comprising master apparatus and secondary apparatus, said master apparatus including a master clock having a minute shaft and an hour shaft, a rotatable contact member associated with said minute shaft and a rotatable contact member associated with said hour shaft, a cooperating rotatable contact member for each of said minute shaft and hour shaft rotatable contact members and adapted to be driven in the same direction as and at a greater rate of speed than said minute and hour shaft contacting members, common driving means for driving said cooperating rotatable contact members at the same speed with respect to each other, said secondary clock including driving means, a circuit extending from said master apparatus and including means for synchronizing the speed of said secondary driving means with the speed of said master apparatus, common driving means, a minute hand positioning means and an hour hand positioning means both of said hand positioning means being driven by said driving means whereby the angular position of each is synchronized with the angular position of said cooperating rotatable contact members in said master apparatus, a minute hand member and an hour hand member for association with each of said hand positioning means, respectively, a second circuit including said minute hand shaft rotatable contact and its cooperating rotatable contact member, an electromagnetic means associated with said minute hand positioning means and included in said second circuit for causing said minute hand positioning means to disengage said minute hand member in an angular position corresponding to the angular position of said minute shaft rotatable contact at the time of contact therewith by said cooperating rotatable contact member, and similar electromagnetic means associated with said hour hand positioning means and in circuit with said hour shaft rotatable contact and said cooperating rotatable contact member.

6. A secondary clock comprising a minute hand, a minute hand rotating element, driving means therefor, frictional means positioned between said driving means and said rotating element, blocking means for blocking said rotating element for a portion of each revolution, if necessary to maintain a predetermined average speed, electromagnetic means responsive to line impulses for actuating said blocking means, a minute hand for said secondary, a member associated with said minute hand and normally extending into the path of said minute hand rotating element to be engaged and driven thereby, means for displacing said member from the path of said rotating element, and electromagnetic means responsive to line impulses for actuating said displacing means.

7. In a secondary clock, a minute hand member, rotary hand positioning means, driving means therefor, electromagnetically actuated means responsive to each impulse of a given group of line impulses for causing said positioning means to disengage said minute hand member in an angular position determined by the time interval between any particular impulse of said group and the preceding impulse of a second group of line impulses, and electromagnetically actuated means responsive to said second group of line impulses for synchronizing the rotation of said positioning means with said second group impulses.

8. A secondary apparatus for a clock system comprising driving means, minute hand positioning means driven thereby, hour hand positioning means driven thereby, a minute hand and an hour hand, a member associated with each of said hands and engaged by the respective positioning means to effect movement of said hands, and electromagnetically actuated means for causing said minute hand positioning means and said hour hand positioning means to disengage said members upon the receipt of minute hand positioning impulses and hour hand positioning impulses, respectively.

9. Secondary apparatus for a clock system comprising a synchronous motor, a clutch including a driving plate driven by said motor and a driven plate for cooperation with said driving plate, electromagnetic means for blocking the rotation of said driven plate, a second hand associated with said driven plate, a minute hand, minute hand positioning means associated with said driven plate, a member associated with said minute hand and periodically engaged by said positioning means to move said minute hand and electromagnetic means for disengaging said member and said positioning means.

10. A secondary clock comprising synchronous driving means, two axially displaceable shafts, a rotatable member loosely mounted on each shaft and driven by said synchronous driving means, each of said members having a projection extending from a face thereof, a member affixed to each of said shafts for engaging the projection on the associated rotatable member whereby its associated shafts may be driven by each of said

rotatable members, electromagnetic means for displacing each of said shafts to cause disengagement of said shafts from said rotating members, a minute hand associated with one of said shafts, and an hour hand associated with the other of said shafts.

11. In a clock system, master apparatus and a secondary clock, a minute hand and an hour hand for said clock, a separate hand positioning element for each of said hands for effecting all movements thereof, the movement of each hand being independent of movement of the other, common driving means for said two elements, an electromagnet responsive to line impulses received from said master apparatus, and means actuated by said electromagnet for synchronizing said driving means with respect to said master apparatus.

GEORGE C. ENGEL.

CERTIFICATE OF CORRECTION.

Patent No. 2,289,636. July 14, 1942.

GEORGE C. ENGEL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 37, claim 7, after "responsive to" insert --each impulse of--; and lines 74 and 75, claim 10, for "whereby its associated shafts may be driven by each of said" read "whereby each of said shafts may be driven by its associated--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of September, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

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