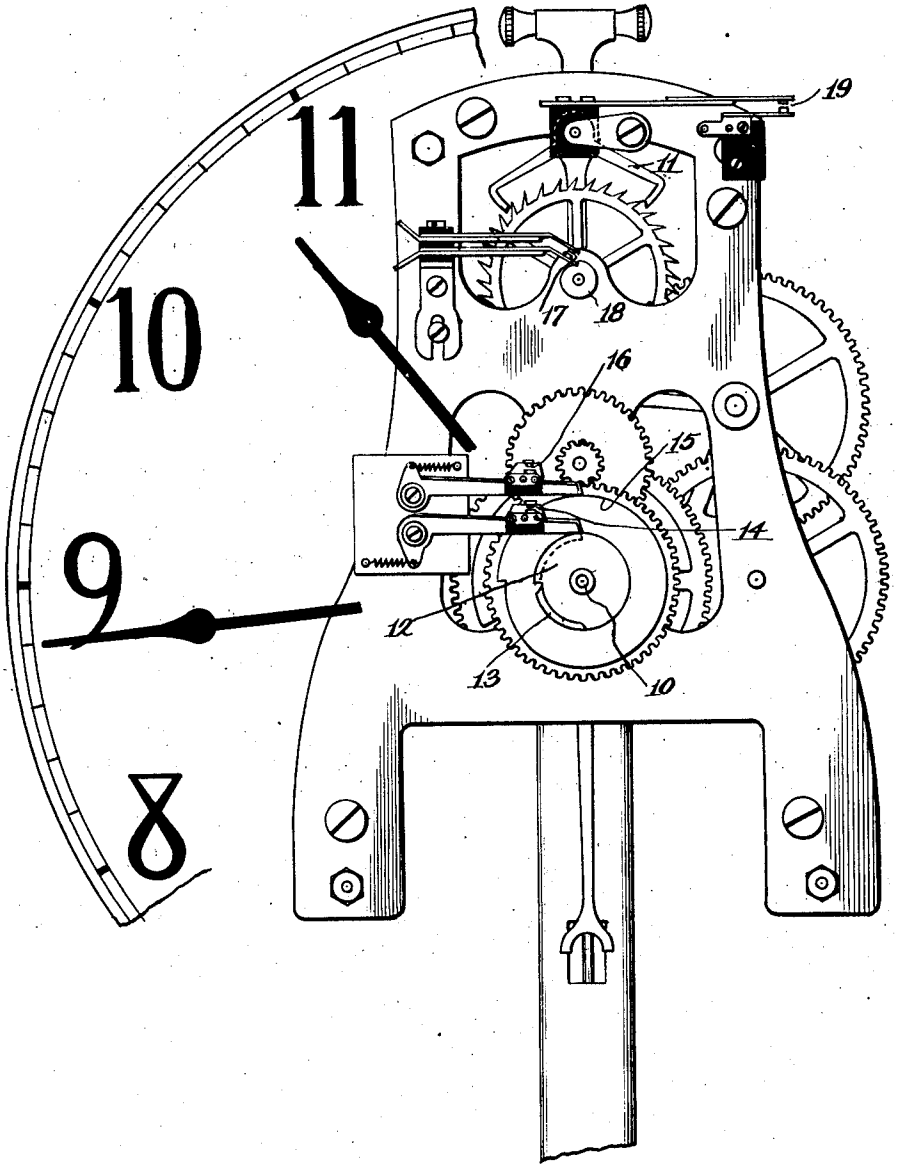
Oct. 16, 1928. 1,687,491

J. W. BRYCE

SYNCHRONIZING CLOCK

Filed June 26, 1924 2 Sheets-Sheet 1

Fig. 1.




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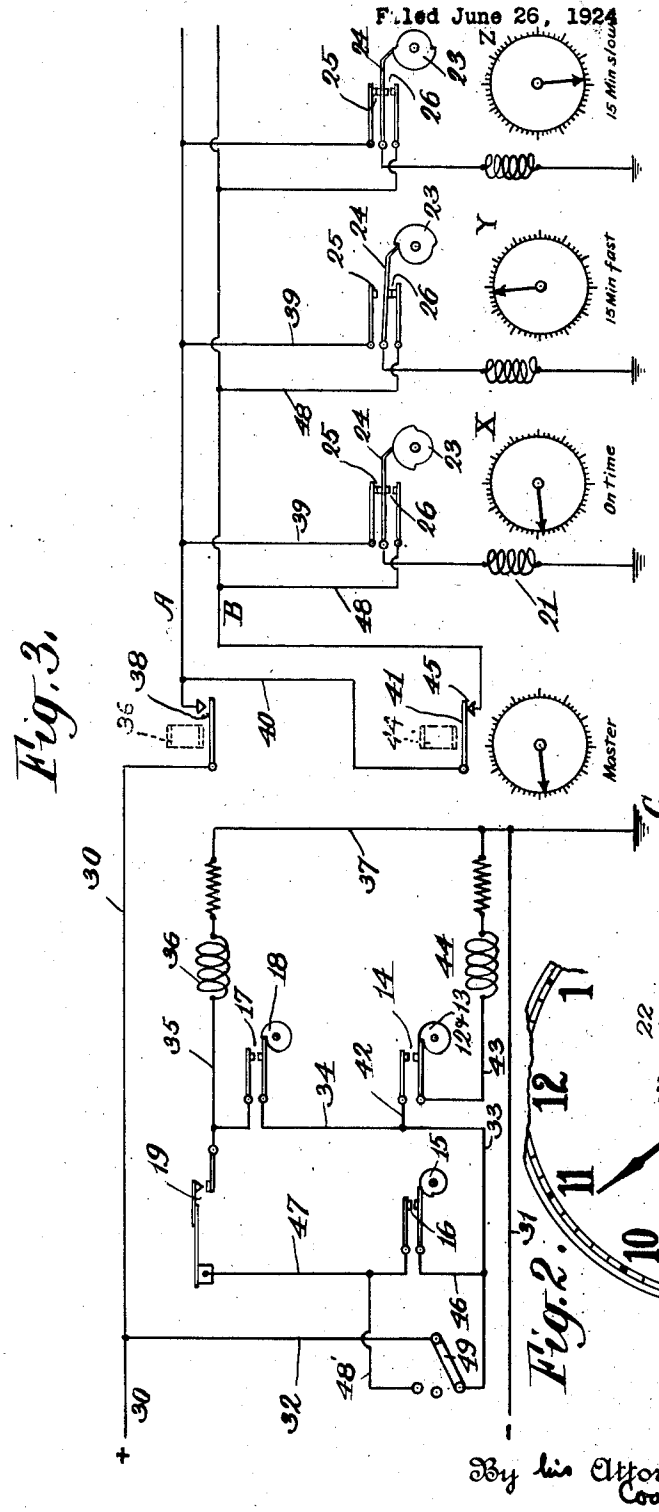



Fig. 3.

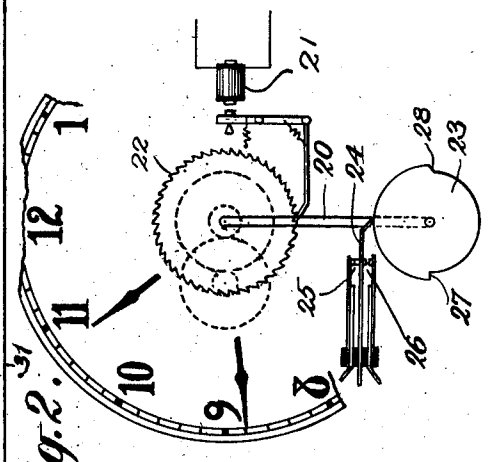


Fig. 2.

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Patented Oct. 16, 1928. 1,687,491

# UNITED STATES PATENT OFFICE.

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## SYNCHRONIZING CLOCK.

Application filed June 26, 1924. Serial No. 722,439.

This invention relates to synchronized clock systems and more particularly relates to the provision of a simplified means for synchronizing secondary impulse clocks which are controlled by a so-called master clock.

I have heretofore devised several systems of synchronizing clocks relatively to a master clock and the present invention is directed to the provision of a simplified and modified arrangement of parts to the general end that the structure of the secondary clocks shall include a less number of parts than heretofore provided.

Further and other objects of the present invention will be hereinafter pointed out in the accompanying specification and claims and shown in the drawings which by way of illustration show one and a preferred embodiment of the invention.

In the drawings:

Fig. 1 is a view showing the pertinent parts of a master clock for use in connection with my improved system.

Fig. 2 is a view of one of the secondary clocks used in the system.

Fig. 3 is a diagram of the master clock and a plurality of secondary clocks which are to be synchronized thereby.

### *Master clock.*

The master clock in its general details may be of any desired form. For example, it may be that shown in my prior Patent No. 1,390,018. Referring to Fig. 1, the master clock includes the usual time train adapted to drive the minute arbor 10 which makes one revolution per hour. The usual verge mechanism 11 is provided. Fixed to the minute shaft are a pair of cams 12, 13, which cams are shaped and positioned to control a pair of contacts 14, of which the position of the upper contact and its arm is controlled by cam 13 and the position of the lower contact and its arm is controlled by cam 12. Preferably the arrangement of parts is such that the contacts 14 are closed for the synchronizing period and opened at other times. It will be obvious, however, that by a proper rearrangement of the associated parts of the system these cam contacts could operate in a reverse manner opening in the synchronizing period and closing at other times.

In the present and preferred embodiment I provide for a synchronizing period commencing when the minute hand of the master clock is forty-four minutes after the hour and terminating at fifty-nine minutes after the hour. In actual practice the contacts closure takes place at forty-four and a fraction and the opening of the contacts occurs at fifty-nine and a fraction for reasons which will hereinafter appear.

Also fixed to the minute arbor 10 is a cam 15 which is adapted to control the opening and closing of a pair of contacts 16. In the preferred embodiment contacts 16 are arranged to close just after the fifty-ninth minute position and open at approximately fifty-nine and a half. For a proper functioning of the apparatus the contacts 16 should open just before contacts 14 open at the end of the synchronizing period.

In addition, the master clock is provided with the usual minute impulse contacts 17 which are controlled in the usual way from a minute cam 18 or otherwise as is the custom in clocks of this sort.

For advancing or stepping forward the secondaries I provide quick acting contacts 19 and preferably operate these contacts by attaching one of them to the verge mechanism 11. These contacts 19 will close at every swing of the pendulum if a pendulum movement is employed.

### *Secondary clock.*

The secondary clock shown in Fig. 2 is of conventional form and it includes a minute arbor shaft 20 which makes one revolution per hour. This shaft is preferably advanced by means of an impulse magnet 21 which acts through the usual ratchet wheel 22 to advance the minute arbor 20 step by step each time the magnet 21 receives an impulse from the master clock. Carried by the minute arbor 20 on each secondary clock I provide a synchronizing cam 23. Cooperating with this cam is a contact device of any desired form here shown as including a blade 24 adapted to close contacts 25 when the raised portion of the cam is under the blade 24 and to close contacts 26 when the blade 24 is on the low portion of the cam. The cam 23 is so timed that when the minute hand of the clock is opposite the fifty-ninth minute the blade 24 has just fallen off the high point 27 of the cam 23 breaking contact 25 and mak-

ing contact 26. The cam rise 28 in the present embodiment of the invention is disposed substantially 180° around the cam from the drop-off point 27 so that at twenty-nine minutes after the hour or slightly thereafter contacts 25 are closed and contacts 26 will be opened. The parts are so arranged that at no time except momentarily during the shifting of blade 24 are both contacts 25 and 26 open.

Referring now to the circuit diagram (Fig. 3) current is supplied from the source not shown to lines 30 and 31. In the present system line 31 is grounded as shown at C and the so-called C circuit forms a common return which may be metallic, if desired. As usual in clock systems of this sort, the circuits employed are complete metallic circuits but for simplicity in the present description a ground return is utilized from the secondary clocks.

The first operation to be described will be the normal minute impulse operations for controlling the secondary clocks. For clarity it will be assumed that the secondary clocks at this moment are at a position after the hour and not yet in the synchronizing period. Current entering at line 30 flows over wires 32, 33 and 34, through minute contact 17, wire 35, master relay coil 36, wire 37, and back to line 31. This energizes the master relay coil 36 once per minute attracting relay arm 38 and causing the current to flow from line 30 through a wire A, thence through wire 39 to contacts 25 to the clock impulse magnet coils 21, ground C and back through the ground or common return to wire 31. In addition to minute impulses being transmitted over lead A minute impulses are also transmitted over a wire B through a circuit traced as follows: from 38 through wire 40, relay arm 41 now in lower position as shown and thence out to line B. Thus during non-synchronizing periods the condition of contacts 25 and 26 is immaterial since the secondaries may receive impulses either over A or B.

The operation just described traces the condition of the system for the usual minute impulse sweeping forward of the secondary clocks and this continues until the synchronizing period begins. At the beginning of the synchronizing period contacts 14 close. This causes current to flow from source 30, wire 32, wire 33, wire 42 through contacts 14 now closed, wire 43, synchronizing relay coil 44 and back through wire 31 to source. The energization of synchronizing relay coil 44 attracts its armature breaking contacts 45 and causing wire B to be cut out of circuit so as to receive no further impulses from the master clock. During the synchronizing period therefore it will be understood that the secondary clocks can only receive normal minute impulses over wire A.

In the diagram of Fig. 3, three secondary clocks are shown marked respectively X, Y and Z. Clock X is assumed to be on time with its minute hand in agreement with the master clock. Clock Y is assumed to be fifteen minutes fast and clock Z fifteen minutes slow. Synchronizing cam 23 of clock X is about the center of its high portion thus closing contacts 25. Cam 23 of the Y or fast clock has reached such position that blade 24 has dropped off step 27 closing contacts 26 and opening contacts 25. Cam 23 of the Z or slow clock has just passed the rise 28 and reclosed contacts 25 opening contacts 26. As previously explained during the period from the beginning to the end of the synchronizing period normal minute impulses from the master clock are only transmitted over the wire A. Therefore clock Y will receive no more normal minute impulses inasmuch as contacts 25 are open. This clock will therefore remain stationary until the end of the synchronizing period. Clocks X and Z, on the other hand, are in such position that contacts 25 are closed and they therefore are in condition to receive minute impulses from the wire A during the synchronizing period. The clocks X and Z then step along in the usual way receiving the normal impulses every minute from line A until the end of the synchronizing period is reached.

Just after the fifty-ninth minute, as shown by the master clock, the cam 15 reaches a position to close the contacts 16. Current now flows from the source 30 over wire 32, wire 46, contacts 16, wire 47, contacts 19 to wire 35 and master relay coil 36, wire 37, return wire 31 and back to source. The contacts 19 close in comparatively rapid succession, for example, once every two seconds and energize coil 36 a plurality of times which attracts armature 38 a plurality of times thereby sending a succession of fast impulses over wire A. It will be understood that on clock X which is on time contacts 25 will have opened at the fifty-ninth impulse thereby preventing the fast step-up impulses from affecting it. Clock Z, on the other hand, will have the parts in such position that contacts 25 are closed so that the fast impulses are received by it which causes the clock to be stepped forward or accelerated turning around the synchronizing cam until it reaches a position to open contacts 25. All of the clocks X, Y and Z are now in synchronism with the master clock. After contacts 19 have sent the selected number of fast impulses, contacts 16 will open thus rendering contacts 19 ineffective to send further impulses. Shortly after contacts 16 open contacts 14 will open thus de-energizing the synchronizing relay coil 44, releasing the armature 41 and allowing contacts 45 to reclose. The preceding action just described should occur just prior to the sending of the next minute impulse, i. e., the sixtieth, as controlled by the reclosing of contacts 17. Contacts 17

now send the usual normal minute impulses over both lines A and B. Inasmuch as contacts 26 on all clocks X, Y and Z are now closed the various secondary clocks take their initial impulse current over the wire B through wires 48, contacts 26, impulse magnets 21 and back through common return C to the source as previously traced.

It will be undertsood that if in any case it is required to correct the time of the entire system, as for example, when the master clock is running fast or slow and this correction is to be within the range permitted by the synchronizing period it is only necessary to reset the hands of the master clock to the desired extent. The secondaries will then set themselves within the next hour. If the amount is in excess of the synchronizing period for which the system is designed, for example, when a daylight saving correction is required, a manual control is brought into operation as shown in Fig. 3 which will now be described. Referring to the diagram a wire 48′ is provided terminating in a switch point as shown. A switch member 49 is disposed in line 32 and for the usual running position is closed in the position shown. To retard the secondary clocks the switch 49 is displaced to the open or off position breaking line 32 and also being out of contact with the switch point on wire 48′. This switch is maintained open for the desired retarding period. If it is desired to advance the clock the switch 49 is thrown to connect with the switch point or wire 48′. The effect of connecting switch 49 with wire 48′ is to cause the fast set-up contacts 19 to come into action and rapidly advance the various secondary clocks. The switch 49 will be held closed until the secondary clocks advance to the desired extent. For example, to advance all of the clocks one hour with contacts 19 closing every two seconds it will take two minutes to bring about the proper advance of the secondaries.

It will be understood that it is not essential to hold switch 49 closed for the exact period inasmuch as the synchronizing system will function to bring the clocks in time with the master clock whether the said secondary clocks are fast or slow with respect to the master clock. It is only necessary that they be brought within the range of the synchronizing period.

The above is equally true with regard to retarding operations it being only necessary to open switch 49 for approximately the desired retarding period.

While in the present embodiment I have selected a synchronizing period of fifteen minutes it will be understood that this period is given merely for purposes of illustration and that this period may be greater or less as desired. In conventional clock systems of the present day this period has been found to be ample for all practical purposes.

In the present system it will be seen that preferably the arrangement is such that the master clock sends out normal impulses, fast impulses, and upon certain circuits or lines sends out normal impulses which are omitted for a time and which recommence at the end of the synchronizing period. Preferably the arrangement is such that the suppressing of the sending of normal impulses is controlled by means associated directly with the master clock and independent of any supplemental devices disposed at or in the secondary clocks. Hence, complicated mechanisms in secondary clocks are unnecessary.

The synchronizing of the secondary clocks is effected by devices disposed at the secondary clocks which are controlled by the impulse magnet or like translating device for advancing the secondary clocks. These synchronizing devices selectively determine whether the secondary clocks shall receive normal impulses, fast impulses, or whether they be so connected as not to receive any impulses for a time.

Although in Fig. 3 plus and minus symbols are shown at the ends of lines 30 and 31 it will be understood that either alternating or direct current may be used as desired and that the symbols are merely used to indicate a source of supply.

The present system is operative to drive and synchronize one or more secondary clocks, individually or collectively, and no matter how many secondary clocks are associated with the system, no secondary clock can exercise any influence on any other secondary clock regardless of what its position may be with respect to true time or what the position of any other secondary clock may be with respect to true time.

What I claim is:—

1. In a synchronizing clock system, in combination with a master clock and one or more secondary clocks, circuits connecting said master and secondary clocks, means associated with said master clock for sending out constant and regular impulses over said circuits, means associated with said master clock only for suppressing the sending out of the constant and regular impulses over certain circuits to said clocks for certain periods of time, and means in said secondary clocks for connecting said clocks to said circuit on which no constant regular impulses are being sent out at a determined time in their operation.

2. In a synchronizing clock system, in combination with a master clock and one or more secondary clocks connected in circuits receiving impulses from the master clock, means associated with the master clock only for suppressing the sending out of current impulses over certain circuits to said secondary clock or clocks for certain time periods, means operative upon the secondary clock or

clocks attaining a condition of synchronism with said master clock for placing said clock or clocks in said circuit over which the sending of impulses is being suppressed, and means controlled by said master clock for the sending out of normal advancing impulses over the aforesaid circuit to again initiate an advancing of the clock or clocks in said circuit.

3. A synchronizing clock system including, in combination, a master clock adapted to send out fast impulses and normal impulses only, and a secondary clock including a translating device for actuating the same by the impulses derived from the master clock, and means controlled solely by said translating device for determining whether said translating device shall receive normal impulses, or fast impulses.

4. A synchronizing clock system including a master clock with provisions for sending impulses over circuits to one or more secondary clocks, means entirely associated with said master clock only for selectively sending out normal current impulses over certain circuits to said clocks, means for also sending out fast impulses over common circuits to said clocks, means for sending out other normal impulses to said clocks for certain time periods and suppressing said sending at other time periods, said suppressing being effected by devices at the master clock only, and means associated with said secondary clock or clocks for selecting the circuit combination from which the said clock or clocks are to receive impulses or over which the sending of impulses is omitted in accordance with the relative time conditions of the secondary clock or clocks.

5. A synchronizing clock system including a master clock, having means for transmitting impulses, a secondary clock, means comprising two conductors each of which transmits normal impulses from said master clock to said secondary, and means under control of said secondary clock for determining whether the latter shall receive normal impulses from one of said conductors or the other.

6. A secondary clock system including lines adapted to transmit normal impulses, fast impulses and for certain periods to omit the sending of impulses thereover, a secondary clock, an impulse magnet therein for driving the same, and means in said secondary clock controlled in its operation solely by the position of the said clock for selectively determining which form of impulses the said clock shall receive or whether said impulse magnet shall be placed in circuit with the line over which impulses are being omitted.

7. A synchronizing clock system including a master clock having provisions for sending out normal and fast impulses over circuits, a secondary clock adapted to be advanced by said impulses, received over said circuits, means in the master clock for selecting the combination of circuits over which the normal and fast impulses are sent out at various times, said means having provision for omitting the sending of any normal regular impulses over certain circuits during certain time periods, and means in the secondary clock for selecting the circuits over which it receives fast or normal impulses in accordance with the time indications of said secondary clock relative to said master clock.

8. A synchronizing system including a master clock, a secondary clock and circuits connecting the same, means for effecting synchronization of said secondary clock with said master clock comprising devices in the master clock for controlling the circuits, an electro-magnet and selecting devices in said secondary clock consisting of circuit controlling devices controlled in their operation solely by the movement of said electro-magnet for variously coupling said electro-magnet to said circuits in accordance with slow, on time, or fast condition of said secondary clock.

9. A synchronizing clock system comprising in combination with a master clock having provisions for sending normal impulses and fast impulses, one or more secondary clocks adapted to be advanced by said impulses, circuits from said master clock to said secondary clocks, and means in said master and said secondary clocks for utilizing various combinations of said circuits for transmitting the normal and fast impulses, said means including provision for effecting synchronization between the master clock and secondary clocks by utilizing only the circuits which transmit the fast and normal impulses.

10. A synchronizing clock system, comprising a master clock and one or more secondary clocks disposed in circuits connected to said master clock and receiving current impulses therethrough derived from the master clock, means in said master clock for transmitting normal impulses upon certain circuits, means in said master clock for transmitting abnormal impulses over one of the aforesaid circuits, and contact devices in said system for combining said circuits for establishing synchronizing conditions while utilizing solely the aforementioned impulse transmitting circuits.

11. In a synchronizing clock system, in combination, a master clock, one or more secondary clocks, a plurality of circuits, means in said master clock for transmitting normal impulses, faster than normal impulses, and for interrupting the transmittal of normal impulses over one of said circuits for determined periods, and secondary devices having provisions for selecting any of said circuits and the two forms of impulses sent out by the master clock in accordance with the indi-

cations of time of said secondary clock or clocks, relative to the time of the master clock.

12. A master clock for use in synchronizing clock systems, said clock comprising in combination, means for sending normal current impulses over certain circuits, means for sending fast impulses over certain circuits, and means operable by said clock for automatically omitting the sending of normal impulses over certain circuits for certain time periods.

13. A synchronizing clock system, comprising in combination with a master clock electrically connected to one or more secondary clocks, means including a minute impulse relay at said master clock for periodically sending normal impulses to said secondary clocks, a synchronizing relay having provisions for controlling the same for automatically omitting the sending of normal impulses over certain lines for determined time periods, and for automatically thereafter recommencing the sending of said impulses, means controlled by said master clock for sending fast impulses, each of said secondary clocks including an impulse magnet, synchronizing cam contact devices operated thereby with provisions for selectively coupling the said magnet to receive normal or fast impulses or to a line upon which no impulses are being sent out by said master clock.

14. A synchronizing clock system including a master clock having means for transmitting impulses, a plurality of secondary clocks, means comprising two conductors each of which transmits normal impulses from said master clock to said secondaries which are connected in multiple therewith and means under control of each secondary clock for determining whether the said clock shall receive normal impulses from one of said conductors or the other.

15. A secondary clock system including lines adapted to transmit normal impulses, fast impulses, and for certain periods to omit the sending of impulses thereover, a secondary clock, an impulse magnet therein for driving the same, and means in said secondary clock comprising a single cam contact member controlled in its operation solely by the position of said clock, said member when in one position placing said secondary clock in circuit with the line over which impulses are being sent and when in another position placing said clock in circuit with a line over which impulses are not being sent.

16. A secondary clock system including lines adapted to transmit normal impulses, fast impulses and for certain periods to omit the sending of impulses thereover, a plurality of secondary clocks, impulse magnets in said clocks for driving the same, means for selectively connecting said magnet to one or the other of said lines, said means being controlled in its operation solely by the position of the clock for selectively determining from which line said clock shall receive impulses or whether it shall be placed in circuit with a line over which impulses are being omitted, said various secondary clocks and their controlling devices being connected in multiple upon said controlling lines.

17. In a synchronizing clock system, the combination comprising a master clock, a secondary clock, a main circuit having a portion thereof comprising a pair of conductors, a relay for closing both of said conductors, a master clock circuit including said relay, translating means for actuating said secondary clock, and means for connecting one or the other of said conductors in series with said translating means.

18. In a synchronizing clock system, the combination comprising a master clock, a secondary clock, a main circuit having a portion thereof comprising a pair of conductors, means for alternately closing and opening said conductors, means for maintaining the first of said conductors open during a definite period of time and during a plurality of closing and opening cycles of operation of said first named means, electro-magnetic actuating means for said secondary clock, and means controlled by said actuating means for causing said electro-magnetic actuating means to be placed in circuit with the second of said conductors during said definite period of time.

19. In a synchronizing clock system, the combination comprising a master clock, a secondary clock, a main circuit having a portion thereof comprising a pair of conductors, means for continually sending impulses over said main circuit, means for maintaining the first of said conductors open during a definite period of time, electro-magnetic operating means for said secondary clock, and means for causing said electro-magnetic operating means to be placed in circuit with the second of said conductors prior to the beginning of said definite period of time when said secondary clock is slower than said master clock.

20. In a synchronizing clock system, the combination comprising a master clock, a secondary clock, a main circuit having a portion thereof comprising a pair of conductors, means for continuously sending impulses over said main circuit, means for maintaining the first of said conductors open during a definite period of time, electro-magnetic means for operating said secondary clock, and means controlled by said operating means for causing said electro-magnetic means to be placed in circuit with the second of said conductors during the greater portion of said definite period of time, and for ter-

minating the association of said electro-magnetic means and said second named conductor during a flow of impulses over said second named conductor.

21. A synchronizing clock system comprising a main circuit having a pair of conductors comprising a portion thereof, a master clock adapted to send out normal impulses over both of said conductors, a secondary clock having a translating device for actuating the same by impulses, means for connecting said translating device with either of said conductors, and contact means operable for transmitting fast impulses to said translating device to advance said secondary clock at a rate greater than a normal rate.

22. A synchronizing clock system comprising a main circuit having a pair of conductors comprising a portion thereof, a secondary clock having a translating device for actuating the same, a master clock adapted to send out normal impulses over one of said conductors for a portion of a definite period of time and to send out normal impulses over the other of said conductors for another portion of said definite period of time, means adapted to transmit fast impulses to said secondary clock, and means controlled by said secondary clock for connecting said translating device to either of said conductors.

23. A synchronizing clock system comprising a main circuit having a pair of conductors comprising a portion thereof, a secondary clock having a translating device for actuating the same, a master clock adapted to send out normal impulses over said main circuit continually, means for sending fast impulses to said translating device, means for suppressing the delivery of normal impulses over one of said conductors periodically, and means controlled by said secondary clock for permitting said translating device to receive impulses from the other conductor of said pair of conductors while delivery of normal impulses is suppressed over the first named conductor.

24. A synchronizing clock system comprising a master clock and a secondary clock including translating means in the secondary clock for receiving current impulses and for effecting all advancing movements of the secondary clock by step-by-step operations, a plurality of conductors extending from the master clock to the secondary clock, means at the master clock for impressing upon one of the conductors normal impulses, means at the master clock for impressing upon said same conductor a series of fast impulses, means at the master clock for suppressing a current impulse upon another conductor, selective switching means in the secondary clock with provisions for cutting off the translating means from the first mentioned conductor and connecting it to the second conductor, and means in the secondary clock, operable under the control of said translating means when operated by impulses from the second conductor, for automatically establishing circuit relations of said translating means with the first mentioned conductor.

25. A synchronizing clock system comprising a master clock, a secondary clock including a translating device in the secondary clock receiving current impulses for effecting all advancing movements of the secondary clock by step-by-step operations, a plurality of conductors extending to said secondary clock from the master clock, means at the master clock for impressing upon both conductors normal impulses, means at the master clock operable to impress fast impulses upon one of said conductors, means at the master clock for omitting the sending of normal impulses over the other of said conductors, and selective switching means in the secondary clock for connecting said secondary clock to either of said conductors.

26. A synchronizing clock system comprising a master clock, a secondary clock of the impulse type adapted to be advanced step-by-step under the control of the master clock, a plurality of conductors connecting said secondary clock and said master clock, means at said secondary clock for selectively connecting said secondary clock to said conductors, means at said master clock operable for sending rapid stepping-up impulses over one of said conductors, means at the secondary clock for automatically disconnecting the secondary clock from the conductor upon which the fast impulses are impressed upon the secondary clock showing a determined time indication, and means at the secondary clock for connecting said secondary clock with another of said conductors over which no impulses are being received.

27. In combination, secondary clock driving mechanism, a plurality of conductors, each adapted to supply impulses to said driving mechanism, and switching means controlled by said secondary clock mechanism for selectively determining which one of said conductors shall supply impulses to said driving mechanism.

28. In combination, secondary clock driving mechanism, a plurality of conductors, each adapted to supply impulses for causing actuation of said driving mechanism, and switching means for alternately transferring the control of said driving mechanism from one to another of said conductors.

29. A secondary clock comprising means adapted to receive electrical impulses and advance the clock mechanism, a plurality of conductors, each adapted to supply electrical impulses to cause advance of the clock mechanism, and switching means controlled by the

clock mechanism for selectively determining which one of said conductors shall control advance of the clock mechanism.

30. A synchronizing clock system including a master clock, a secondary clock, circuits connecting said clocks, means for automatically synchronizing said clocks, said means comprising devices to automatically advance the secondary clock at a comparatively rapid rate, and means disposed at the master clock adapted, when manipulated, to prolong indefinitely the rapid advance of said secondary clock.

In testimony whereof I hereto affix my signature.

JAMES W. BRYCE.