

J. W. BRYCE.
 SYNCHRONIZING CLOCK SYSTEM.
 APPLICATION FILED NOV. 16, 1918.

1,310,787.

Patented July 22, 1919.

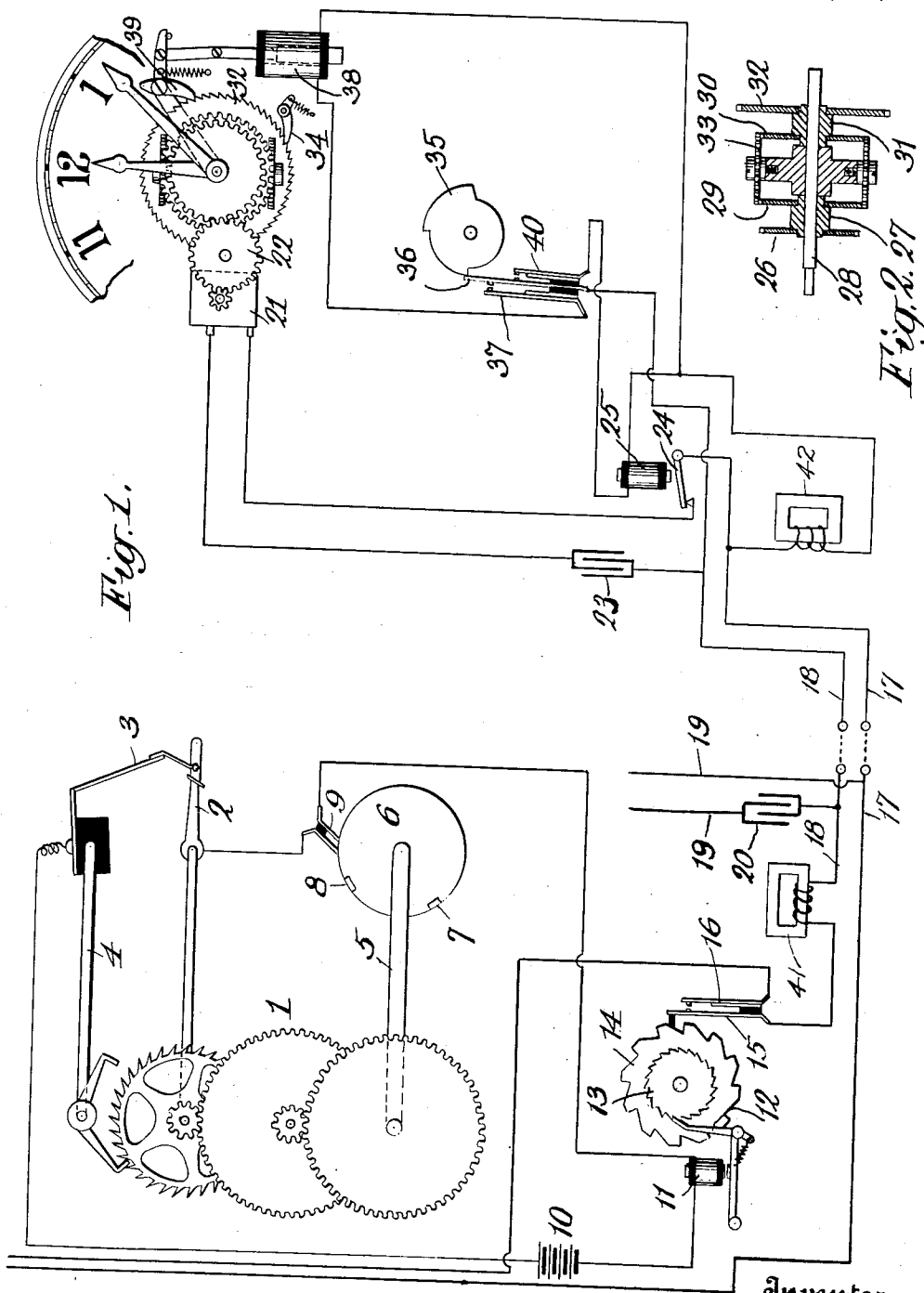


Fig. 1.

Fig. 2.

Inventor
 James W. Bryce
 By his Attorneys
 Kerr, Pugh, Cooper & Hayward

UNITED STATES PATENT OFFICE.

JAMES W. BRYCE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO INTERNATIONAL TIME RECORDING COMPANY OF NEW YORK, A CORPORATION OF NEW YORK.

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Specification of Letters Patent.

Patented July 22, 1919.

Application filed November 16, 1918. Serial No. 262,756.

To all whom it may concern:

Be it known that I, JAMES W. BRYCE, a citizen of the United States, residing at Binghamton, county of Broome, and State of New York, have invented certain new and useful Improvements in Synchronizing Clock Systems, of which the following is a full, clear, and exact description.

This invention is an improvement in synchronizing clock systems and is based upon the principles of the system set forth and claimed in an application filed by me on May 21st, 1918, Ser. No. 235,813, being an improvement on such systems.

When a master clock is employed to operate and control a number of secondary clocks particularly where such secondaries are used for the control of such devices as time recorders or the like, it is necessary that some effective means be employed for maintaining the secondaries under all the conditions to which they are generally subjected, in perfect synchronism with the master clock and to bring them into true synchronism after even wide departures from correct time, such as may result from temporary failure of the main or operating current, varying load or other causes.

It not infrequently happens that the available source of current for operating the clocks is alternating, and when such current is one of comparatively steady frequency it may be employed without other aids as the means for driving the clocks. For example, it may be transmitted direct from the original or from a corrective source when necessary, over the clock line and used to operate synchronous motors properly geared to drive the clocks on approximate time, at the rate of rotation which is imparted by the line current. Such motors are now on the market that have the capability of self-starting and are available for this purpose notwithstanding the occurrence of interruptions of the supply or driving current.

In such a system, however, many things conspire to throw the secondary clocks out of synchronism with the master clock. Variations of load, interruption in the current supply, or variations in the frequency which despite the most careful precautions are liable to occur, all tend to accelerate or retard the secondary and this invention is designed to provide a means for periodically

bringing the secondaries into exact synchronism in case they depart therefrom.

In carrying out my invention I use but a single line circuit over which the alternating operative current is constantly transmitted, but over this circuit I also send at definite predetermined intervals of substantial duration a continuous corrective current which through the instrumentality of special mechanism in the secondary clocks will operate if a clock be too fast, to stop its motor or what would be the equivalent its driving effect, until the master clock had caught up, or if it be too slow, to advance its hands to an extent that will cause them to indicate the same time as the master clock.

This system is illustrated in the accompanying drawing, in which—

Figure 1 is a diagram showing sufficiently for purposes of the case, a master clock and one secondary, which latter, it will be understood is typical of any number that may be used under the control of the same master clock.

Fig. 2 is a sectional view of a differential gear.

The master clock train is designated by the numeral 1. The minute arbor of the clock carries an arm 2, having an inclined end with which a contact 3, oscillated by the verge shaft 4, makes wiping contact one a minute. The hour shaft 5 carries a disk 6 having the conducting segments 7, 8, in the periphery, upon which bear a pair of contact springs 9. The segments 7, 8, are so placed that the segment 7 comes under contacts 9 at exactly fifteen minutes of the hour, and segment 8 at the even hour, and by this means the circuit of a local source of current 10, is completed through the brushes 9 at intervals of fifteen minutes.

The circuit of the source 10 includes an electro-magnet 11 which operates through a pawl 12 to turn step by step a ratchet wheel 13, which imparts a similar movement to a larger ratchet wheel 14 upon the teeth of which bears a stop on a spring contact 15. When said stop is on the top of a tooth its contact engages a second contact 16 and this engagement is broken by the movement of the ratchet 14 that brings the stop opposite a space between teeth.

By the movement of the clock the current from source 10 is directed through the contact 3, the arm 2 and the brushes 9 and con-

tact 7 at exactly fifteen minutes of the hour and this turns the ratchet 14 and brings together contacts 15 and 16 which close to line the circuit of any available source of direct current, until by the next movement of the ratchet 14 fifteen minutes later this circuit is interrupted.

The clock operating or actuating current from any source available is sent to line 17, 18 by wires 19, one of which includes a condenser 20 which interrupts only a direct current.

Each secondary clock contains a synchronous motor 21 geared to the train 22, which drives the hands. Normally the alternating current received from the line flows over line 18, through the condenser 23, the motor 21 and back to wire 17 through the armature 24, of a relay 25 which is normally deenergized. This runs the clock and should keep it on time.

The clock train in gear with the motor 21 includes a gear wheel 26 fixed to the hub 27 turning loosely on the spindle 28, and carrying one member 29 of a differential gear. The other member 30 of this gear is on a loose hub 31 carrying also a ratchet wheel 32 and the floating member 33 of the differential is fixed to and drives the clock shaft 28. The ratchet wheel 32 is normally locked against movement by a pawl 34 so that the rotation of the motor imparted to gear wheel 22 rotates the floating member of the differential and this turns the clock shaft 28.

On the hour shaft of the secondary clock is a cam disk 35 and when the clock is on time the high part of the cam engaging with a spring contact 36 forces the latter into engagement with a contact 37 at say thirty minutes of the hour and maintains such engagement until exactly fifteen minutes of the hour, or the instant when the flow of direct current over the line begins. In this event nothing will happen as the circuit between contacts 36 and 37 is broken at the moment that the direct current begins to flow. But should the secondary be slow, then this engagement of contacts 36 and 37 continues after the direct current begins to flow over the line, and the latter therefore entering by wire 18 passes from contact 36 to contact 37 and thence through an electro-magnet 38 that operates a pawl 39 engaging with the ratchet wheel 32 and by the movement of this wheel the floating member 33 of the differential and the minute hand of the clock is advanced until the contacts 36 and 37 are separated, as they will be by the forward movement of the clock train, at which time the position of the hands of the secondary will exactly correspond with that of the hands of the master clock. The throw of the pawl 39 is of such extent that a possible movement of

90° may be imparted by it to the minute hand, which is sufficient to meet all possible contingencies.

Again the contact 36 is permitted to move into engagement with a contact 40 at exactly the even hour when the secondary is on time, or at the instant when the flow of direct current over the main line ceases. In this event nothing happens, but should the secondary be too fast then this engagement is made before the hour, so that the line current will flow from contact 36 to contact 40 and thence through relay magnet 25 and back to line.

This causes the lifting of armature 24 and the interruption of the main circuit to the motor 21 with a result that the secondary clock stops until the master clock breaks the flow of direct current at the even hour, when magnet 25 is deenergized and the clock motor again starts.

As a direct and an alternating current are superimposed on the same circuit, means must be employed to prevent the alternating current from following the parts intended only for the direct current and conversely. For this purpose the condensers 20 and 25 are used to check the flow of direct current, and reactance coils 41 and 42 of low ohmic, but very high reactive resistance are used to check the alternating current wherever necessary. These are matters which are well understood by those skilled in the art.

In the carrying out of this invention I have shown specific means which involve the stoppage of the secondary clock or the advancement of its hands, but it is obvious that any other means for accomplishing the same purpose may be used, and that the terms retarding or accelerating will more adequately express what is accomplished. I may, in other words, employ any means capable of exercising these functions.

Having now described my invention what I claim is:—

1. In a synchronizing clock system in which the secondary clocks are operated by alternating currents, the combination with a master clock which sends over the alternating current line a direct current for predetermined intervals of definite duration, of one or more secondary clocks, means therein for retarding and means for accelerating their movements, circuit controllers operated by the secondary clocks for connecting said devices with the line at predetermined intervals in fixed relation to the time as indicated by the hands of said clocks, and means for permitting or preventing either an alternating or a direct current to flow over such parts of the circuit as may be required.

2. In a synchronizing clock system, the combination with a master clock, one or

more secondary clocks and a line circuit between the same, of a source of alternating current permanently connected to the line circuit, a source of direct current, means in
5 the master clock for connecting said source with the line at predetermined intervals of definite extent, means in each secondary clock for retarding or for accelerating its rate, circuit controllers operated by the sec-
10 ondary clocks for connecting said means

with the line at intervals of definite duration in fixed relation to the time as indicated by the hands of the secondaries, and means for permitting and for preventing the flow of either the alternating or the
15 direct current over such portions of the circuit as may be required.

In testimony whereof I hereunto affix my signature.

JAMES W. BRYCE.