(No Model.) 4 Sheets—Sheet 1.

H. S. PRENTISS.

SYNCHRONIZER FOR ELECTRIC CLOCKS.

No. 452,956. Patented May 26, 1891.

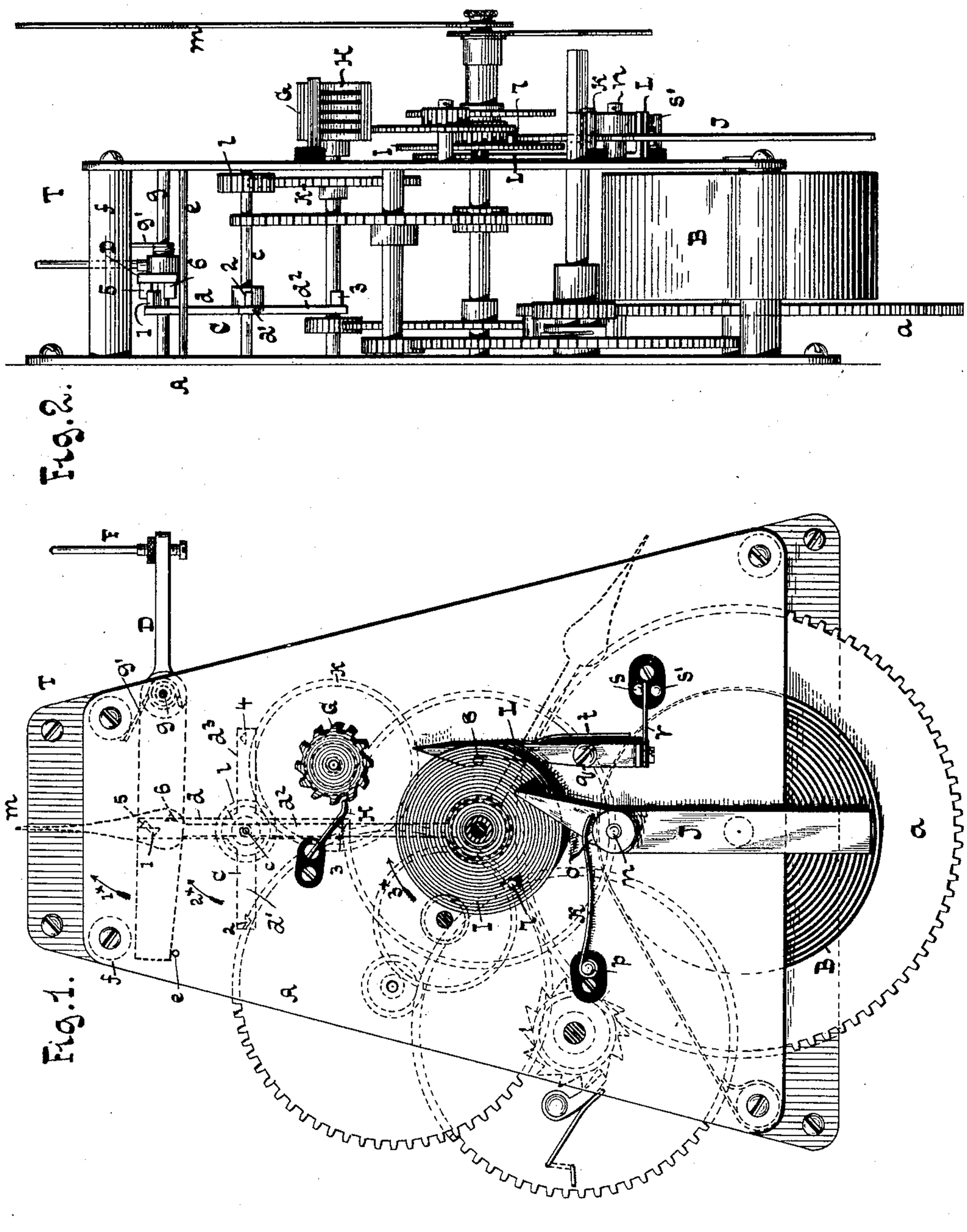

Fig. 2.

Fig. 1.

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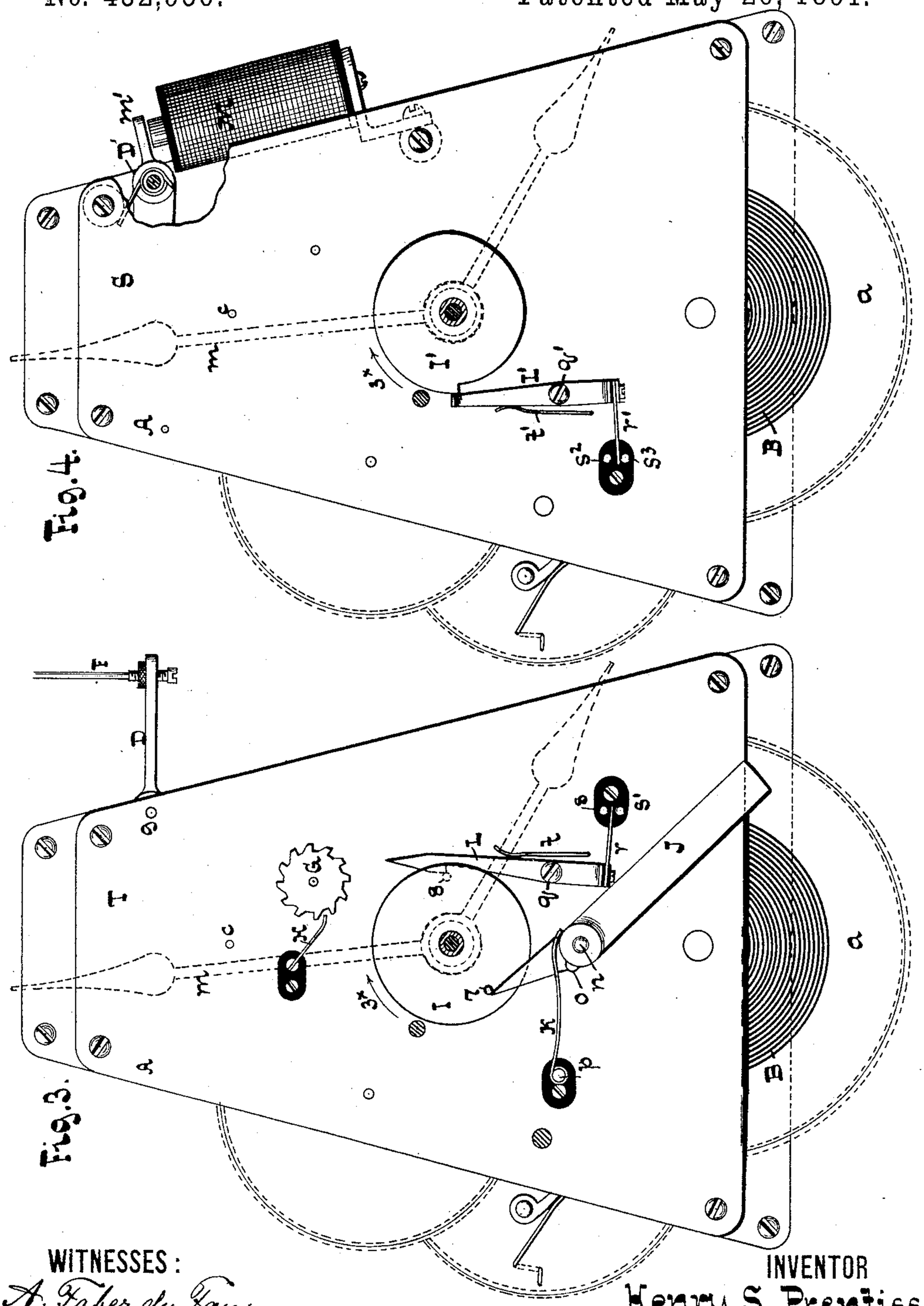

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SYNCHRONIZER FOR ELECTRIC CLOCKS.

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Fig. 5.

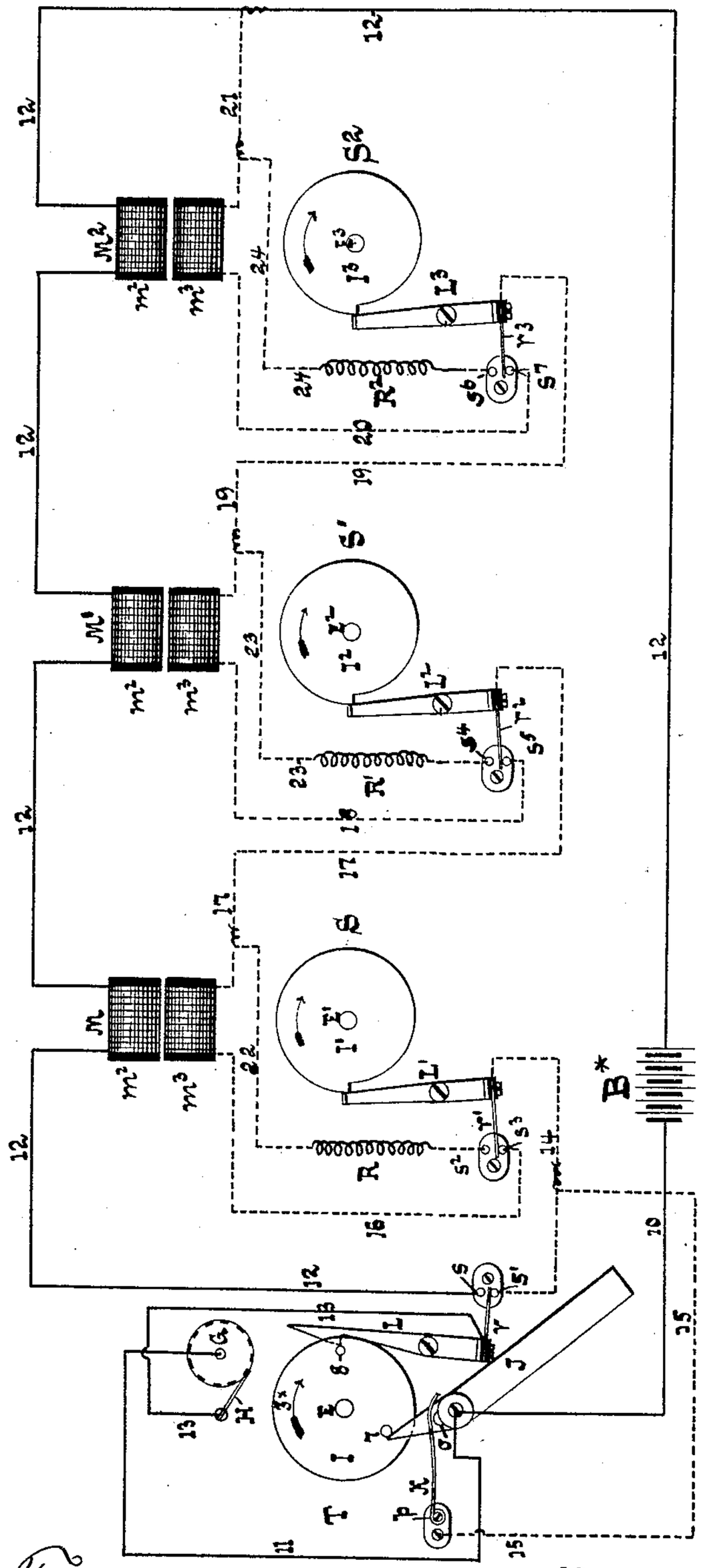

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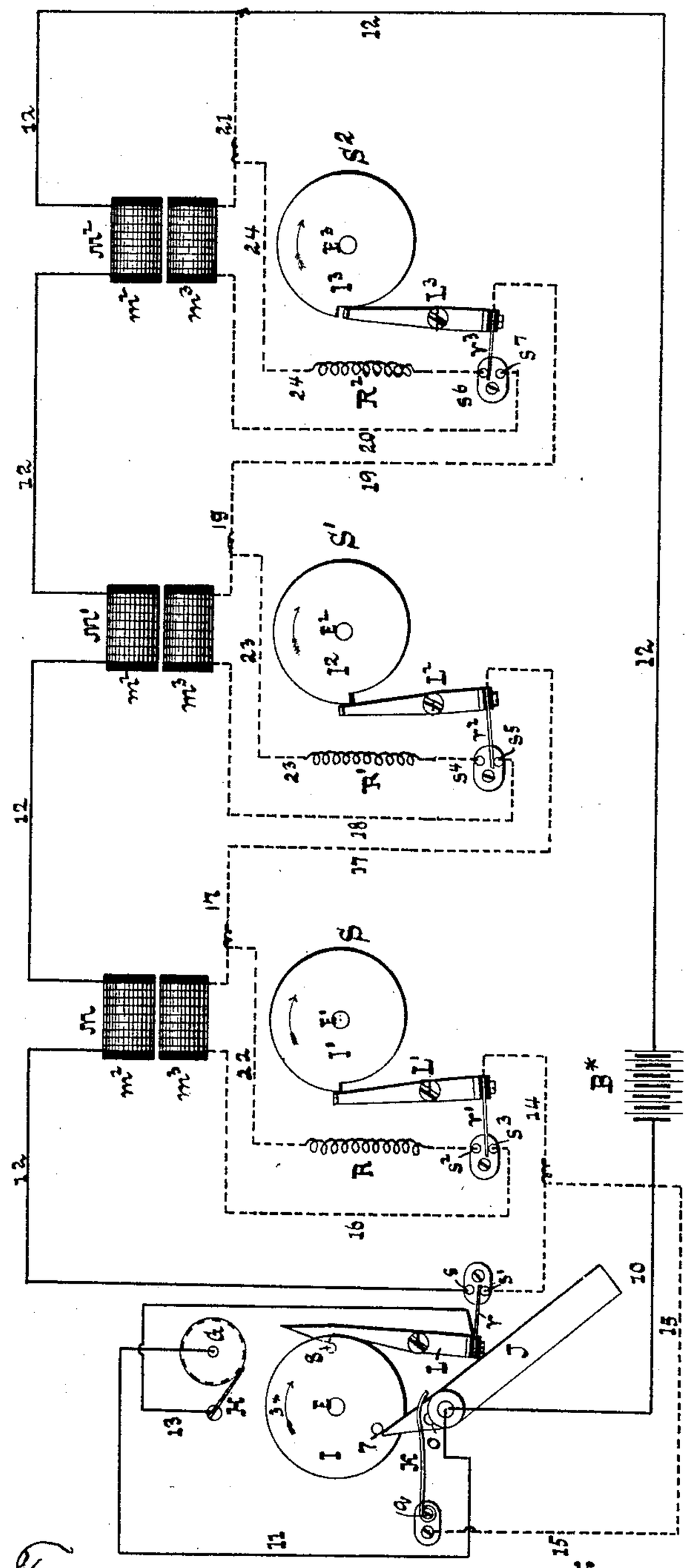
Fig. 6.



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UNITED STATES PATENT OFFICE.

HENRY S. PRENTISS, OF ELIZABETH, NEW JERSEY.

SYNCHRONIZER FOR ELECTRIC CLOCKS.

SPECIFICATION forming part of Letters Patent No. 452,956, dated May 26, 1891.

Application filed June 6, 1890. Serial No. 354,448. (No model.)

To all whom it may concern:

Be it known that I, HENRY S. PRENTISS, a citizen of the United States, and a resident of Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Synchronizers for Electric Clocks, of which the following is a specification.

My invention has reference to synchronizers for electric or electro-mechanical clocks; and it consists, essentially, in combining with a series of secondary clocks a primary clock or a transmitter having an incorporated synchronizing device for sending repeated impulses through the secondary clocks at the expiration of the synchronizing period. The primary clock or transmitter is provided with a main-circuit closer through which the circuit of the main line is closed at determinated intervals to actuate the secondary clocks, and with means for switching the current through the synchronizing line at a certain predetermined time before the expiration of the synchronizing period. Each secondary clock embodies a switch, which, dependent on the time indicated by the clock, either establishes the circuit through the clock to receive the impulses sent through the synchronizing line prior to the expiration of the synchronizing period to receive the same, and also part or all of the impulses of the synchronizing-circuit closer, or it cuts the clock out of the circuit to lose part or all of the impulses sent through the synchronizing line prior to the expiration of the synchronizing period, and also the impulses sent by the synchronizing-circuit closer. In practice the main-line circuit is broken at the main switch and closed through the synchronizing line five minutes in advance of the hour or the expiration of the synchronizing period, whereby all the hands of the clocks continue to be advanced as before, with the exception of those which may be fast, which latter lose part or all of the impulses. At the end of each hour or the expiration of the synchronizing period the synchronizing-circuit closer is permitted to operate and repeated impulses are sent through the synchronizing line. Such of the clocks as may be slow receive these impulses and their hands are advanced until brought to the correct time, provided the error does not exceed certain limits. Such as may be correct lose all the synchronizing impulses, and those which may be or may have been fast, besides losing part or all of the impulses sent through the synchronizing line before the expiration of the synchronizing period, lose also the synchronizing impulses at the termination of the synchronizing period.

My invention furthermore embodies certain details in construction of the synchronizing devices and switches, all of which are more fully pointed out in the following specification and claims, and illustrated in the accompanying drawings, in which—

Figure 1 represents a face view of a transmitter provided with my improved synchronizing-circuit closer and switch. Fig. 2 is a side view thereof. Fig. 3 is a face view of the transmitter, showing the synchronizing-circuit closer in a different position from that shown in Fig. 1. Fig. 4 is a face view of a secondary clock embodying my invention. Fig. 5 is a diagram illustrating the electrical connections, all the clocks being here shown as indicating the correct time. Fig. 6 is a similar diagram, some of the clocks, however, being slow and others fast.

Similar letters and figures indicate corresponding parts.

In these drawings I have shown my invention applied to electro-mechanical clocks in which the movements are normally held out of action and released periodically to move the hands through a space corresponding to the time elapsed. However I do not wish to restrict myself to the use of the synchronizing device to this particular class of clocks, as it can be equally well applied to purely electrical clocks.

Referring at present to Figs. 1 and 2, the letter A designates the frame of the transmitter T, said frame being provided with suitable bearings for the several parts of a train constituting a usual form of clock-movement, of which B is the mainspring, and *a* the first or great wheel. This latter wheel is ultimately connected through the train of wheels with a pinion *l*, rigidly mounted upon an arbor *c*, upon which latter is secured to turn therewith a scape-wheel C, formed with a number of radial arms *d*, *d'*, d^2, and d^3, provided near their outer terminals with laterally-projecting teeth 1, 2, 3, and 4. These teeth are adapted to be successively engaged

in the rotation of the scape-wheel by the pallets 5 and 6 of pallet-lever D, arranged to vibrate about a pivot *g*, the motion of said pallet-lever being limited in either direction by contact with suitable stops, such as *e* and *f*. The pallets 5 and 6 of the pallet-lever it will be noticed are in different vertical and horizontal planes. Referring to Fig. 1, the pallet-lever is normally held against the stop *e* by the pressure of a spring *g'*, in which position of the pallet-lever the upper pallet 5 thereon is in the proper position to cross the path of the teeth on the scape-wheel and to prevent the rotation of the latter by engagement with the upper portion of one of its teeth—say tooth 1. Consequently the train is held out of action. If now the pallet-lever D is turned about its pivot in the direction of arrow 1*, Fig. 1, tooth 1 is released from pallet 5 and the scape-wheel can turn in the direction of arrow 2*. The pallet-lever now being against pallet *f*, the stop 6 thereon is in the proper plane to engage with the lower edge of tooth 1. Consequently the scape-wheel at this stage rotates only through a very small arc when its motion is arrested by pallet 6. The pallet-lever now returning to its normal position against stop *e*, pallet 6 releases tooth 1 and the scape-wheel completes a quarter of a revolution, whereupon its motion is arrested by engagement of its tooth 2 with pallet 5 of the anchor. The proportions of the train in this example are such that for each quarter of a revolution of the scape-wheel the hands move over a space on the dial corresponding to one minute of time.

The release of the transmitter-movement can be effected by various means—for instance, by its connection with a master or primary clock by the rod F, which depresses the pallet-lever D once a minute; or the transmitter could embody a train having an intermittent movement—such, for instance, as that described in Letters Patent No. 416,804, granted to me December 10, 1889, whereby it would constitute both a primary clock and a transmitter.

The circuit-closer of the transmitter consists, preferably, of a contact-wheel G and a brush H, the former being connected by gears *k* and *l* with the arbor *c* of the scape-wheel, said gears being so proportioned that the contact is closed once for each quarter of a revolution of the scape-wheel—that is to say, once every minute.

On the arbor E of the minute-hand *m* is rigidly mounted a disk I, provided with two projections or pins 7 and 8, arranged on opposite sides thereof. The pin 7 is adapted in the rotation of the disk to engage with one end of a swinging arm or lever J, pivoted at *n* to the frame. This arm or lever, which I shall hereinafter term the "synchronizing-circuit closer," can swing freely about its pivot, and when not engaged by the pin 7 hangs in an approximately perpendicular position. On the hub of the lever, to one side of the center line, is formed a contact *o*, opposite to which and extending past the same is arranged a spring contact-arm K, secured to a suitable post *p*, insulated from the frame of the transmitter. In the rotation of the disk I in the direction of arrow 3*, Fig. 1, the pin once in each rotation engages with the synchronizing-circuit closer and gradually turns it about its pivot until it reaches the position shown in Fig. 3, whereupon in the further rotation of the disk the circuit-closer is released. The impulse thereby imparted to the circuit-closer causes repeated vibrations of the same, and for each oscillation the circuit is closed once at the contact *o* and contact K.

The pin 8 on the opposite side of the disk I is arranged to engage with one arm of a lever or switch L, pivoted at *q* to the frame and provided at its lower end with a contact or brush *r*, playing between two stationary contacts *s s'*, insulated from the frame. A spring *t*, bearing against the switch, normally holds the contact *r* against the contact *s*. When, however, the pin 8 engages with the switch, it is turned about its pivot to bring the contact *r* against stop *s'*. The pin, coming opposite a notched portion of the lever, permits the same to fall back to its normal position. It will be noticed that the contact *r* of the switch L is brought into contact with the contact *s'* at some time before the hour or the expiration of the synchronizing period, and in practice I make this contact preferably at least five minutes before the hour, for a reason to be subsequently explained.

The secondary clock S, referring to Fig. 4, is identical in construction to the transmitter as far as the train and escapement devices are concerned, with the exception that the pallet-lever D' is provided with an armature *m'*, in juxtaposition with which is arranged an electro-magnet M, which attracts said armature whenever one of its bobbins is vitalized.

On the arbor of the minute-hand *m* is rigidly mounted a cam I', which engages with a switch L', pivoted at *q'* to the frame and provided at its lower end with a contact or brush *r'*, playing between two contacts s^2 s^3, insulated from the frame. A spring *t'*, bearing against the switch, holds the same against the cam. While the upper end of the switch is in contact with the elevated portion of the cam the contact *r'* is in engagement with contact s^3. When, however, said switch is in engagement with the depressed portion of the cam, the contact *r'* is in engagement with contact s^2. It will be noticed that approximately one-half of the cam I' is elevated and one-half depressed, so that for one-half an hour the contact *r'* is in engagement with the contact s^3 and for the same time it is in engagement with contact s^2.

It now remains to describe the arrangement of the circuits and the operation of the synchronizing device.

In Fig. 5 I have shown the clocks arranged

in a series, T being the primary clock or transmitter, G H the circuit-closer, S, S′, and S^2 the several secondary clocks, B* the battery or other source of electricity, and M, M′, and M^2 the respective electro-magnets embodied in the secondary clocks. These electro-magnets may be double wound—*i. e.*, covered with a coil each of the main line and synchronizing line—or, as shown in this drawing, one coil of the magnet is connected with the main line and one with the synchronizing line.

The connections of the transmitter or primary clock are as follows: One pole of battery B* is connected by wire 10 with the contact *o* of synchronizing-circuit closer J. From thence a wire 11 connects with the disk G of circuit-closer G H. From H a wire leads to the contact *r* of the main switch L, and contact *s* thereof is connected by wire 12 with the coil m^2 of the electro-magnets M, M′, M^2, 12* being the return-wire to the opposite pole of the battery.

The synchonizing-circuit is as follows: The contact *s′* of main switch L is connected by a wire 14 with the contact *r′* of switch-lever L′ of secondary clock S. Wire 15 connects contact K with wire 14. Wire 16 connects contact s^3 of switch L′ with one end of the coil m^3 of electro-magnet M. Wire 17 connects the opposite end of the coil with contact r^2 of switch L^2 on clock S′, the contact s^5 of said switch being connected with one end of the coil m^3 of electro-magnet M′ by wire 18. The opposite end of said coil is connected by wire 19 with contact r^3 of switch L^3 on clock S^2. The contact s^7 of clock S^2 is similarly connected by wire 20 to coil m^3 of clock S^2, the opposite end of said coil being connected by wire 21 with the return-wire 12*. The contacts s^2, s^4, and s^6 are connected, respectively, with wires 17, 19, and 21 by wires 22, 23, and 24, suitable resistances R, R′, and R^2 being interposed to balance the line in case any one of the clocks is cut out. During the main part of the hour the switch L is in a position to close the circuit at contact *s*. The impulses now pass through the main-line wire as follows: From one pole of the battery over wires 10 and 11 to contact G, contact H, wire 13, contact *r* of the main switch, contact *s* through the coils m^2 of the electro-magnets M, M′, and M^2, and wire 12* to the battery, thereby advancing the hands of the clocks by one minute for each impulse. When, however, the hands of the primary clock or transmitter are within five minutes of the hour or expiration of the synchronizing period, the pin 8 engages the main switch and throws it into the position shown in Fig. 5. Consequently the circuit is now closed through the synchronizing line, as follows: From one pole of battery B*, over wires 10 and 11, contacts G H, wire 13, contact *r*, contact *s′*, wire 14, contact *r′*, stop s^3, wire 16, coil m^3 of electro-magnet M, wire 17, contact r^2, contact s^5, wire 18, coil m^3 of electro-magnet M′, wire 19 to contact r^3, contact s^7, wire 20, coil m^3 of electro-magnet M^2, wire 21, and through return-wire 12* to the opposite pole of battery, thereby releasing the train of the secondary clocks once each minute, as before. At the termination of the hour or the synchronizing period the synchronizing-circuit closer drops, and repeated electrical impulses are sent into the synchronizing line. The clocks all being correct in Fig. 5, the switches L′, L^2, and L^3 at the termination of the hour or synchronizing period will be in position to bring contacts r', r^2, and r^3 into engagement with contacts s^2, s^4, and s^6, consequently all the impulses sent by the synchronizing-circuit closer J will be lost—*i. e.*, passed through the resistances R, R′, and R^2.

In Fig. 6 I have shown the clock S correct, clock S′ slow, and clock S^2 as having been fast by six minutes. The time on the primary clock is shown within one minute of the hour. Consequently the current will pass through the circuit as follows: battery B*, wires 10 and 11, contacts G H, wire 13, contacts *r* and *s′*, wire 14, contacts *r′* and s^3, wire 16, coil m^3 of electro-magnet M, thereby bringing the clock S to the hour, whereupon its switch is turned to bring contact *r′* against contact s^2. From the coil m^3 the current passes over wire 17, contacts r^2 s^5, wire 18, and coil m^3 of electro-magnet M′ to advance the hands of the clock S′ by one minute. From coil m^3 of electro-magnet M′ the current passes over wire 19, contacts r^3 s^6, resistance R^2, wires 24 and 21 to return-wire 12 and to the battery. Consequently the clock S^2 is cut out of the circuit another minute.

At the hour or the expiration of the synchronizing period the synchronizing-circuit closer is released and the circuit is now closed as follows: battery B*, over wire 10, contacts *o* K, wires 15 and 14, resistance R, wire 22, wire 17, contacts r^2 s^5, wire 18, and coil m^3 of electro-magnet M′, thereby advancing the hands of clock S′ one minute and bringing it to the correct time, whereupon the switch L^2 breaks contact at s^5 and closes it at s^4. From the coil m^3 of electro-magnet M′ the current passes over wire 19, contacts r^3 and s^7, resistance R^2, and wires 24, 21, and 12* back to the battery. The next impulse sent by the synchronizing impulse will be lost to all the clocks. It will be noticed that clock S^2 has remained out of action for five minutes and is still one minute fast. At the next period it will be cut out of synchronizing circuit for one impulse and then resume action.

It is evident that the circuit could be closed through the synchronizing line ten or more minutes in advance of the expiration of the synchronizing period. However, five minutes in advance is sufficient for all practical purposes.

I do not wish to restrict myself to the gravitating synchronizing device herein described, as it is evident that a spring could be substituted to repeatedly close the circuit.

In practice I have found that the synchronizing-lever makes from three to five vibrations at each release, so that an error of three to five minutes can be rectified at the lapse of each synchronizing period.

The construction of the transmitter-movement, the secondary clock-movement, as well as the connections between the transmitter and the primary clock and the main-circuit closer I have fully described in a pending application, filed June 6, 1890, Serial No. 354,447, and therefore I do not claim the same in this application.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an electric-clock system, a switch actuated at determined intervals to break the connection at the main line and to close it through a synchronizing line, in combination with a series of switches, one for each clock, for throwing such clocks into or out of the synchronizing line, substantially as described.

2. A primary clock or transmitter provided with a main-circuit closer, a main switch, and a synchronizing-circuit closer automatically set into operation at determinate intervals by the clock or transmitter, substantially as described.

3. In an electric-clock system, a switch actuated at determinate intervals to break the connection at the main line and to close it through the synchronizing line and a synchronizing-circuit closer adapted to repeatedly close the circuit through the synchronizing line at the expiration of the synchronizing period, substantially as described.

4. In an electric-clock system, a synchronizing-circuit closer adapted to repeatedly close the circuit through the synchronizing line at determinate intervals, in combination with switches for throwing the respective clocks into or out of the circuit, substantially as described.

5. In an electric-clock system, a primary clock (or transmitter) provided with a main-circuit closer, a synchronizing-circuit closer, and a main switch, in combination with a series of secondary clocks, each provided with a switch to throw its respective clock into or out of the synchronizing line, a battery, and electrical connections, substantially as described.

6. A primary clock (or transmitter) provided with a switch for closing the circuit through the synchronizing line in advance of the synchronizing period, substantially as described.

7. A primary clock (or transmitter) provided with a switch for closing the circuit through the synchronizing line in advance of the synchronizing period, in combination with a circuit-closer thrown into action at the expiration of the synchronizing period, substantially as described.

8. A primary clock (or transmitter) provided with means for closing the circuit through the main line and a switch for breaking said circuit and closing it through a synchronizing line, in combination with a circuit-closer thrown into action at the expiration of the synchronizing period to send repeated impulses through the synchronizing line, substantially as described.

9. A circuit-closer consisting of the pendulous lever J, combined with contacts *o* and *k*, substantially as described.

10. A circuit-closer consisting of the pendulous lever J, combined with the contacts *o* and *k* and disk I, engaging with said lever, substantially as described.

11. A clock provided with a main-circuit closer, a switch, and a synchronizing-circuit closer, in combination with the disk I for actuating the switch and releasing the synchronizing-circuit closer, substantially as described.

12. In combination with a primary clock or transmitter, a circuit-closer consisting of a vibratory arm or lever released at determined intervals by the clock for repeatedly making contact, and a flexible contact arranged to be engaged by said arm or lever in its vibrations, substantially as described.

13. A secondary electric clock provided with a doubly-wound magnet or two separate magnets acting upon a common armature and respectively connected with the main line and synchronizing line, and a switch adapted to close the circuit through the clock or to cut the clock out of the circuit, substantially as described.

14. In an electric-clock system, two electric circuits, a series of electric clocks connected with the two circuits, a switch for closing the current through either circuit, and means whereby the clocks are advanced by the passage of the current through either circuit, substantially as described.

15. In an electric-clock system, two electric circuits, a series of electric clocks connected with the two circuits, whereby the clocks are advanced by the passage of the current through either circuit, and means actuated by the clocks to throw said clocks out of one of the circuits, substantially as described.

16. In an electric-clock system, two electric circuits, two magnets arranged to act upon a common armature and connected independently with the two circuits, or a doubly-wound magnet similarly connected, whereby the passage of the current through either circuit or through both circuits at the same time will produce an equivalent effect upon the armature, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 2d day of June, 1890.

HENRY S. PRENTISS.

Witnesses:
GEORGE A. CROOK,
L. N. LEGENDRE.