(No Model.) 2 Sheets—Sheet 1.

E. WESTON.

ELECTRIC TIME INDICATING APPARATUS.

No. 480,890. Patented Aug. 16, 1892.

Fig. 1.

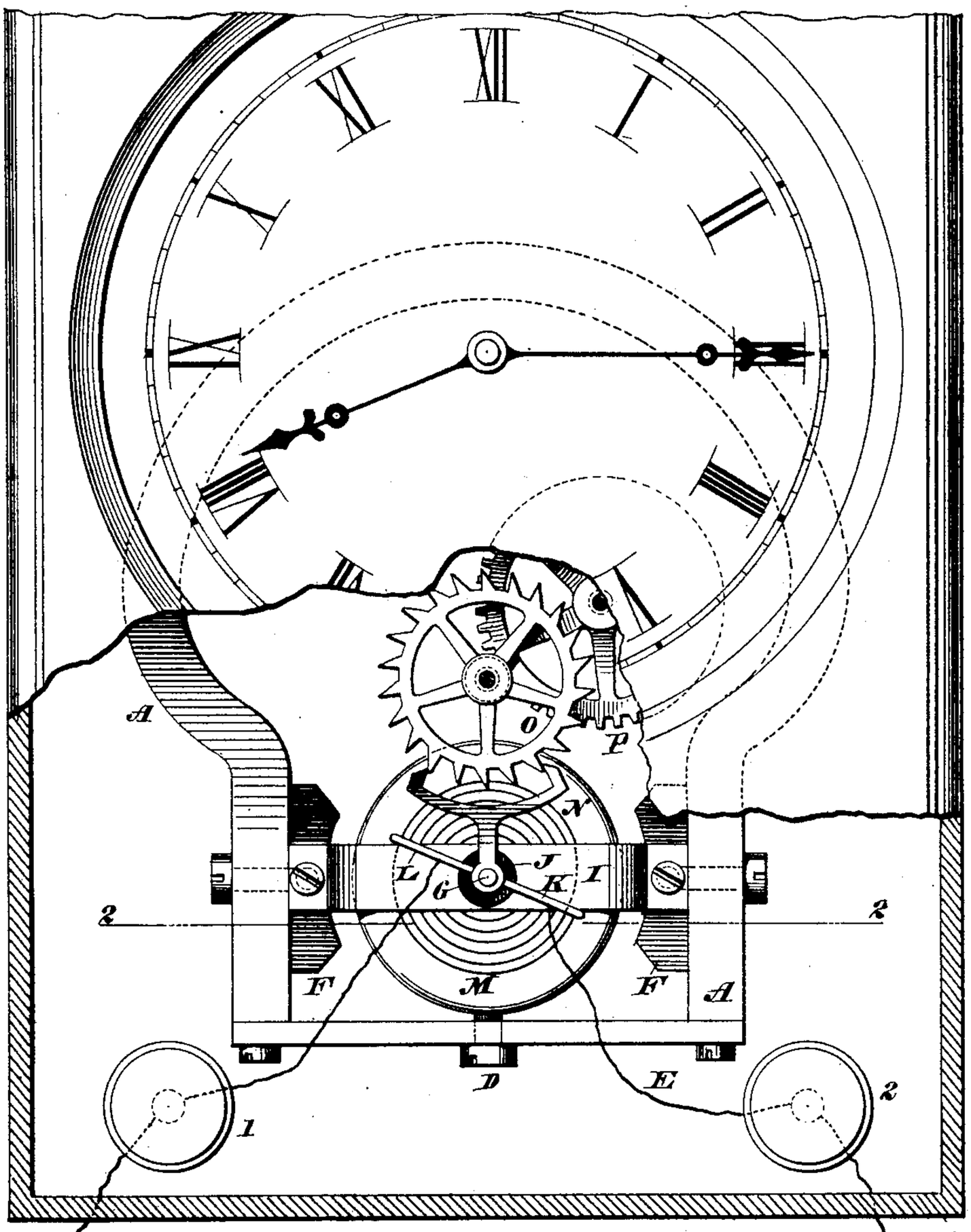
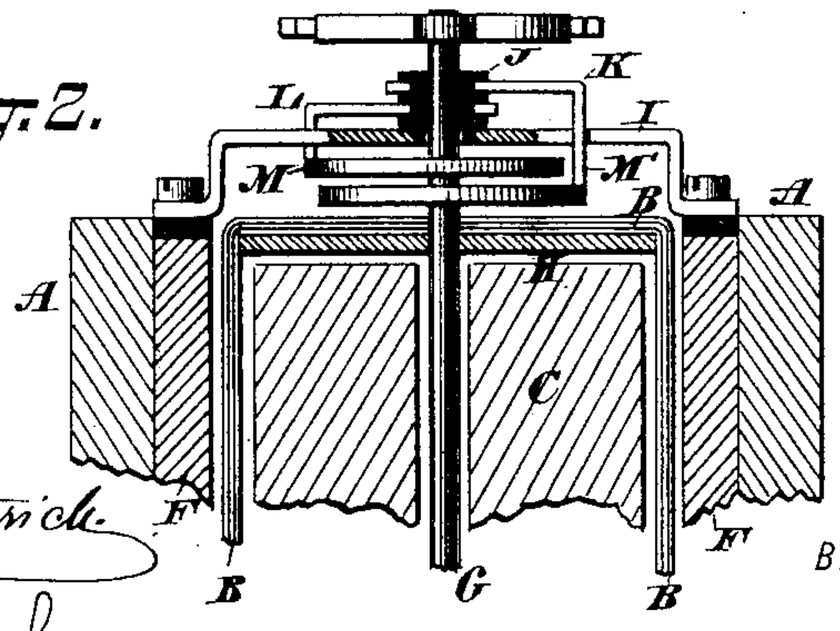


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

E. WESTON.

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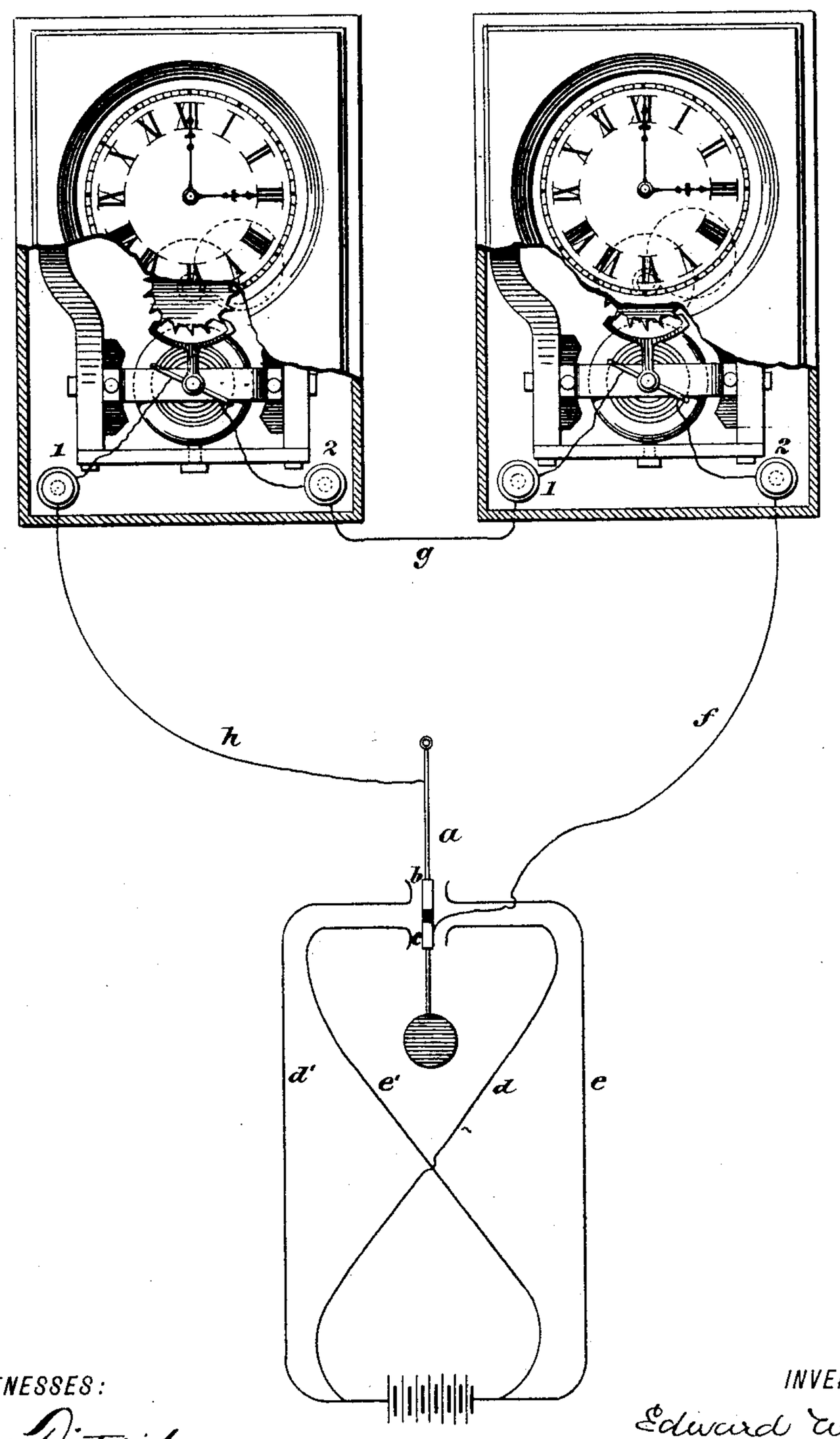
Fig. 3.



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UNITED STATES PATENT OFFICE.

EDWARD WESTON, OF NEWARK, NEW JERSEY.

ELECTRIC TIME-INDICATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 480,890, dated August 16, 1892.

Application filed June 4, 1891. Serial No. 395,132. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WESTON, of Newark, Essex county, New Jersey, have invented a new and useful Improvement in Electrical Indicating Apparatus, of which the following is a specification.

The principle of my invention is as follows: to organize an instrumentality which under the operation of electrical impulses will cause vibrations of a loop-conductor in a field of force and thereby actuate an indicating device. I embody this principle, broadly, in a combination which includes a means of producing a field of force, a loop-conductor vibrating therein on the passage of a current through said conductor, and an indicating device actuated by said conductor, which device may be organized to show the number of vibrations of the conductor, or the number of electric impulses causing said vibrations, or the duration of time intervals between successive impulses, and consequent vibrations or the duration of the said impulses and hence of the vibrations. An indicating device in the same combination which shows simply the extent of movement of the conductor is not herein claimed, inasmuch as this is fully set forth by me in Letters Patent granted to me November 6, 1888, hereinafter referred to, and to other Letters Patent granted to me.

In my present application I show and describe one embodiment of my said invention, whereby it may be practically operated to produce a useful and beneficial result—namely, the transmission and distribution of time. I do not, however, limit it to that specific application, because it is adaptable to many other useful purposes, and, in fact, wherever electrical impulses are to be transmitted at one part of a circuit to actuate an indicating device at another part—as, for example, in telegraphing.

In the accompanying drawings, Figure 1 is a front view of an electric clock having a portion of the cover or face-plate broken away to show the interior construction. Fig. 2 is a sectional view on the line 2 2 of Fig. 1. Fig. 3 shows the arrangement of two electric clocks with a chronometric device for sending an electric impulse over the circuit at regular predetermined intervals.

Similar letters of reference indicate like parts.

The instrument may be divided into two parts; first, an ordinary clock, preferably not provided, however, with any spring, weight, or other motor mechanism for its train, and second, an electro-motive device by means of which the clock-train is actuated at certain predetermined intervals to cause a proper movement of the hands.

The principle governing the electrical portion of my apparatus will be found set forth in Letters Patent, No. 392,387, granted to me November 6, 1888, and in other patents of subsequent date wherein I have described analogous apparatus.

As in the instrument described in my aforesaid patent of November 6, 1888, my present device contains a magnet A, between the poles of which is disposed a pivoted coil B of fine insulated wire. This coil is supported in normal position by counterbalancing-springs, to be hereinafter described. When traversed by a current, the said coil tends to place itself across the lines of force in the magnetic field, thus rotating over a distance which in accordance with well-known laws bears a relation to the difference of potential between the terminals of the instrument. In the apparatus of my prior patent I avail myself of this principle to adapt the apparatus to use as an electrical measuring-instrument, adding a scale and index to show the amount of angular movement of the coil. Such measuring-instruments have been made in large numbers by me and are now in wide and extensive use throughout this country and abroad. In the present case the movement of the coil is not used to measure the current, but is caused by a current of a strength adapted to the purpose intended—namely, to produce a movement of the coil of sufficient amplitude and force to actuate the clock mechanism. In order to produce such movement, I find a current of very low strength amply sufficient, and the additional load of a well-constructed clock-train does not add very materially to the energy required. It follows therefore that I may place in circuit a large number of clocks, each actuated by its own electric apparatus, the operation of all of which devices will be practically simultanous, so that an

electric impulse sent over the circuit will advance the hands in every clock to practically the same extent. I say practically, because whatever variation there may be within reasonable limits—say, for example, one hundred clocks—will be unimportant so far as the indication of time with sufficient approximation to accuracy is concerned.

Referring now to the mechanism employed, C is a cylinder of soft iron or other magnetic material, which is supported by a screw D on the brass bar E, which in turn is supported on the poles of the magnet A. Between the cylinder C and the pole-pieces F of the magnet there is therefore an intense magnetic field through which the coil B passes. The coil B is supported on a shaft G, which extends through a central opening of the cylinder C. At its opposite end this shaft is held in a suitable step-bearing. (Not shown.) Upon it are fastened two bars of pasteboard, aluminium, or other light material, one of which is shown at H, and these support the coil B. The shaft G extends through a bearing in the fixed bar I, which is fastened to the pole-pieces F. On the bar I is a sleeve or collar of insulating material J, which receives two bent arms K and L. To the bent-over end of the arm L is secured one end of a coiled spring M, the other end of which is fastened to the pivot-shaft G. To the end of the arm K is secured one end of a spring M′, the other end of which is also secured to the pivot-shaft G. These two springs may be wound in opposite directions to counterbalance and hold the shaft in normal position. They may be adjusted relatively to one another by suitably turning the arms K and L to tighten or loosen them. The circuit connections are preferably to be such as to lead the current from one binding-post, as 1, through one spring, as M, thence through the coil B and out at the other spring M′ and binding-post 2, as fully shown and described in my prior patent, No. 392,387, dated November 6, 1888. Supported on the extremity of the pivot-shaft G is an anchor N, which engages with an escapement-wheel O. The escapement-wheel in turn gears with a time-train, one wheel of which is shown at P, and communicates motion to said train. The construction of the train is not fully shown here; but any ordinary train, such as is usually driven by a spring or weight, can be used, the relation of the hour and minute hands and the gearing being the same as in any ordinary timepiece. It is to be understood that motion is here transmitted from the anchor to the pallets of the wheel O, and not, as in the ordinary clock-escapement, from the escapement-wheel to the anchor. At each half-vibration of the anchor one tooth of the wheel is freed and another one acted upon, and of course this vibration may be caused at regularly-determined intervals by simply sending a current into the instrument sufficient to cause the proper movement of the coil on its axis. An arrangement of two of these electric clocks, in connection with means of sending an alternately-reversed and direct current through the instrument, is represented in Fig. 3. The transmitting apparatus is here only illustrated in diagram, which, it should be understood, symbolizes any form of device for accomplishing the same result—namely, the transmission of an electric impulse or alternately-reversed impulses through the circuit.

In Fig. 3, *a* represents an ordinary pendulum carrying two contact-pieces *b c*, which are insulated from one another. The battery-terminals *d e* are arranged at one side of the contact-plates *b c*, and the terminals *d′ e′* are disposed on the opposite sides of said contact-plates *b c*. The contact-plate *c* connects by wire *f* with binding-post 2 of one electric clock, from which the circuit passes through the coil of that instrument, and thence to the binding-post 1, thence by wire *g* to binding-post 2 of the second instrument and through its coil and binding-post 1, and then by wire *h* back to the pendulum-rod *a*. It will be obvious that when the pendulum moves to the left its contact-plates *b c* will make contact with the terminals *d′ e′*, and when it swings to the right its contact-plates will meet the terminals *d e*, whence, obviously, a current from the battery will proceed alternately through the wire *b*, the instruments, and back through wire *f*, and then through wire *f*, through the instruments, back through wire *b*. In consequence of this reversing of the current the coils of both instruments simultaneously will oscillate first in one direction and then in the other, thus causing simultaneous vibrations of the anchor N and consequent movement of the clock-train. For all practical purposes it will probably be sufficient to cause an impulse to pass upon the line once in every minute or half minute, and this may be done either by the vibration of a pendulum or by any kind of chronometric apparatus.

I desire to direct especial attention to the fact that the motor energy for the clocks is supplied by the current which is sent over the line and is not developed by the agency of electro-magnets, and that the clocks have no springs or weights or other independent means of driving them. Where the energy in a time system is applied through the agency of an electro-magnet there is a constant source of error present due to the fact that opposed to the variable energizing force derived from battery is the practically-constant force of the retracting-spring of the armature. In order to overcome this constant force at all times, there must be present a large excess of battery-power; but where a comparatively large current is conveyed there is always more or less sparking and consequent destruction at the metallic contacts, which soon destroy them; and, furthermore, by reason of the fact

that contact is made and broken, a powerful extra current appears at each clock, due to the high self-induction of the coils.

In order to avoid the effects of the extra currents and to reduce the amount of current, which acts injuriously upon the contacts, it is customary to construct a shunt around the electro-magnets; but the effect of this again is to reduce the current below what is needed for the comparatively heavy armature and associated parts, so that in attempting to cure one difficulty another is always met.

It will be observed that in my device there are no electro-magnets to be energized and that the motive power is derived from a coil which is disposed in a strong magnetic field, and the motion of which is due to the reaction of its own field produced by the current upon said permanent field. This coil is always to be made of few turns of wire and of small inductive capacity. The motion of the coil is simply due to difference in potential between the terminals of the instrument, and a very slight difference is quite sufficient to effect this motion, so that, as I have already pointed out, the strength of the current required is exceedingly small—so small, in fact, that theoretically, at least, it is probable that as many as one thousand clocks arranged substantially as herein described might be driven at the expense of no more electrical energy than is required for the controlling of one clock under the existing electro-magnetic systems.

It will be observed that in my present device I actuate the coil first in one direction and then in the other by means of an alternating current obtained from a battery. It will be evident that I may use a direct current to move the coil in one direction against the action of a spring, for example, which spring may, when the current is interrupted, restore the coil to its original position. The current therefore may either directly cause the motion of the coil or it may act upon the spring to compress it or wind it, which spring in expanding may actuate the coil.

I do not wish to be understood as stating that my device cannot be used to control or regulate the clock as well as to drive it, for, obviously, this can be done by the apparatus here illustrated by the simple addition of a spring, weight, or any other motive device to the clock-train in the usual way. In such case the spring will drive the train, but the movement of the latter will be permitted and regulated by the vibrations of the anchor due to the movement of the coil just as an ordinary clock-train is regulated by the movement of the anchor due to the vibrations of the pendulum. The arrangement of the mechanism without the driving-springs, however, is greatly to be preferred.

In practice I propose to locate the controlling-chronometer at any central station and to locate the clocks at different points in circuit with the controlling instrument, so that they will receive an electric impulse therefrom at certain predetermined intervals.

It will be obvious that the time-train, dial, and index here illustrated constitute an example of an indicating device which shows, first, the number of vibrations made by the coil; second, the intervals between the vibrations, these being the periods during which the minute-hand remains at rest; third, the number of said intervals, which corresponds to the number of vibrations, and, fourth, the duration of each impulse, which is the period during which the minute-hand is in motion.

By the term "means of producing a field of force" herein used I mean any device, electrical or magnetic, for that purpose. By a "loop-conductor" I mean a conductor in coil or loop form, and so made in order to include in its loop a number of the lines of force of the field. By the term "indicating device" or "device for showing the result of the vibration of the loop-conductor" I mean any device which imparts such information, whether audibly or visibly, or by simple indication or by record or register. By the term "chronometric device for causing electrical impulses" I mean any device which, controlled or actuated by chronometric mechanism of any sort, will either establish or interrupt or vary the electro-motive force or the resistance to the current on the line at certain intervals. By "time-train" I mean any known transmitting mechanism which may be interposed between the motor and the index of any timepiece.

I claim—

1. A means of producing a field of force, a loop-conductor vibrating therein on the passage of a current, and a device actuated by said conductor for showing the number of its vibrations.

2. A means of producing a field of force, a loop-conductor vibrating therein, a means of causing an electric impulse to traverse said conductor at intervals, and an indicating device actuated by said conductor.

3. Transmitting time electrically by causing an electric impulse at predetermined time-intervals to traverse a loop-conductor disposed in a magnetic field, and thereby effecting a series of movements of said conductor and the consequent operation thereby of a time-indicating device.

4. Transmitting time electrically to separated stations by causing from a central station an electric impulse to traverse at predetermined intervals a series of loop-conductors disposed in magnetic fields connected in electrical circuit and located at said separated stations, and thereby effecting a series of simultaneous movements of said conductors and the consequent operation thereby of time-indicating devices.

5. Transmitting time electrically by causing alternately-reversed electric impulses at predetermined intervals to traverse a loop-conductor vibrating or oscillating in a mag-

netic field, and thereby causing said conductor to vibrate or oscillate in alternately opposite directions, and thus to actuate a time-indicating device.

6. A means of producing a field of force, a loop-conductor vibrating therein on the passage of a current, and a time-train actuated by the movement of said conductor.

7. A means of producing a field of force, a loop-conductor vibrating therein, and a time-train intermittently operated by the movement of said conductor due to the passage of a current.

8. A means of producing a field of force, a loop-conductor vibrating therein, a time-train, and a step-by-step transmitting mechanism actuated by said conductor and operating said time-train.

9. A means of producing a field of force, a loop-conductor vibrating therein, a controlling chronometric device for causing an electric impulse to traverse said conductor at definite intervals, and an indicating device controlled by the vibrations of said conductor.

10. At each of a series of separated stations a means of producing a field of force, a loop-conductor vibrating therein, and an indicating device controlled by the vibrations of said conductor, and at a central or transmitting station a chronometric device for causing electrical impulses to pass at definite intervals over a circuit including said loop-conductors.

11. The combination, with a time-train, index, and dial, of a magnet, a coil vibratory in the field of force thereof, and transmitting mechanism between said train and said coil, whereby the motion of said coil is caused to actuate said time-train.

12. The combination, with a time-train, index, and dial, of a magnet, a coil vibratory in the field of force thereof, springs for balancing and adjusting the extent of motion of said coil, and transmitting mechanism between said train and said coil, whereby the motion of said coil is caused to actuate said time-train.

13. The combination, with a time-train, index, and dial, of a magnet, a coil vibratory in the field of force thereof, transmitting mechanism between said train and said coil, whereby the motion of said coil is caused to actuate said time-train, and a chronometric device for establishing alternately-reversed currents in a circuit including said coil.

14. The combination, with a time-train, index, and dial, a magnet A, and coil H, vibrating on an axial pivot in the field of said magnet, of a toothed wheel O, geared with said time-train, and an anchor N on said coil pivot-shaft and engaging with said wheel O.

EDWARD WESTON.

Witnesses:
R. C. FESSENDEN,
A. F. CONERY, Jr.