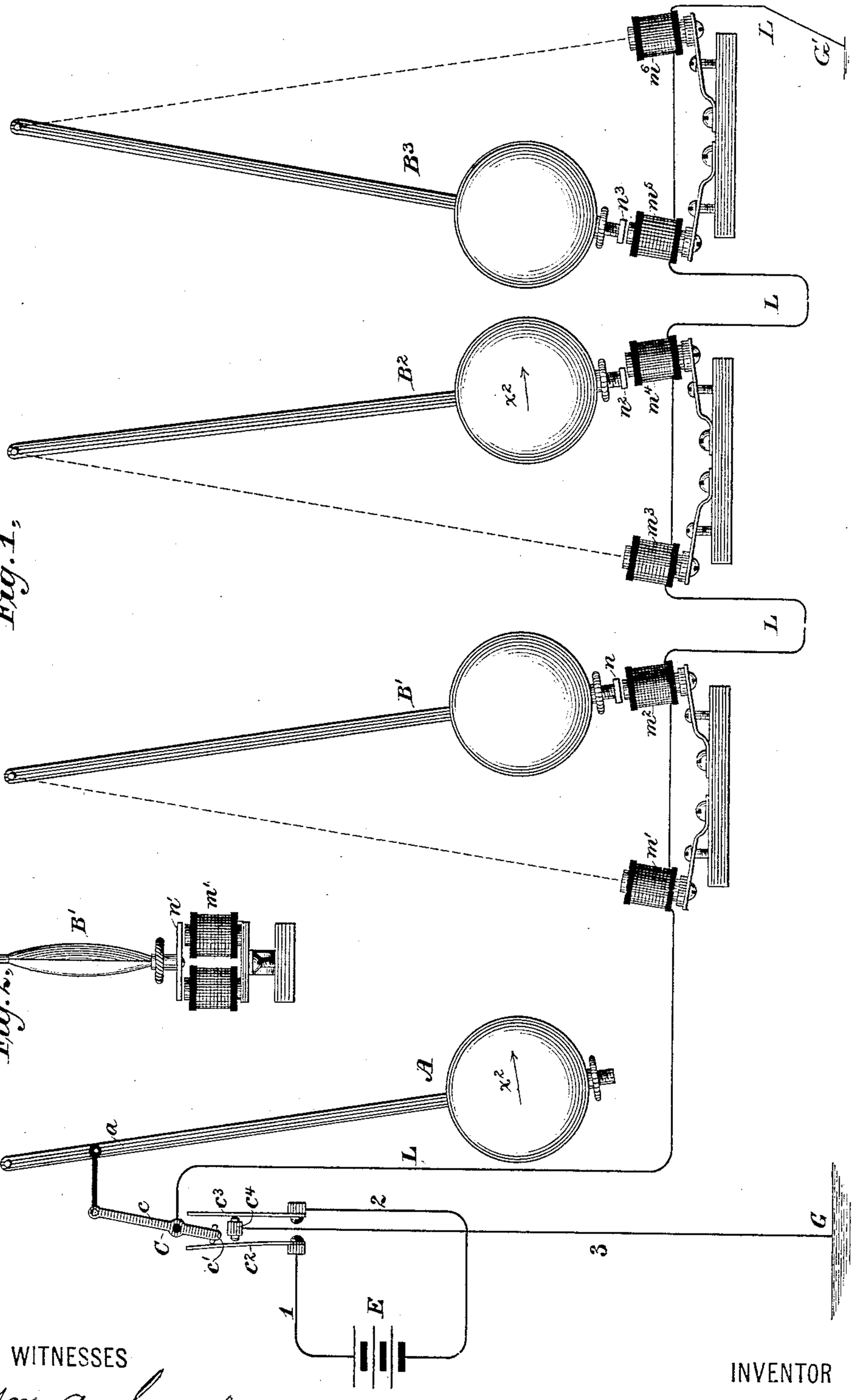
(No Model.)

V. HIMMER.

ELECTRIC DEVICE FOR SYNCHRONIZING CLOCK PENDULUMS.

No. 294,132. Patented Feb. 26, 1884.



WITNESSES

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ELECTRIC DEVICE FOR SYNCHRONIZING CLOCK-PENDULUMS.

SPECIFICATION forming part of Letters Patent No. 294,132, dated February 26, 1884.

Application filed April 17, 1883. (No model.)

To all whom it may concern:

Be it known that I, VITALIS HIMMER, a citizen of the United States, and a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Electrical Devices for Synchronizing Clocks, of which the following is a specification.

My invention relates to a class of electrical apparatus applied to the pendulums of clocks, and acting thereon to retard or accelerate the movements of the same, as may be necessary for the purpose of maintaining their vibrations in unison with those of a standard regulator.

The object of the invention is to so apply the modifying force that it will act to bring the pendulums into unison, whatever may be the relative positions which they have been caused to assume through the influence of any external force, and also to prevent the magnetic portions of the apparatus from acquiring a permanent polarization.

The invention consists in applying to the pendulum of a standard clock or regulator a suitable device for periodically completing an electric circuit through a series of electro-magnets applied to the pendulums of a series of automatically-actuated clocks, and in placing upon each pendulum a soft-iron armature, which is caused at each vibration to pass within the field of force of two of those electro-magnets respectively placed near the opposite limits of its arc of vibration.

The invention also consists in so organizing the circuit-closing device that each successive impulse transmitted thereby through the electro-magnet shall be in the opposite direction or of opposite polarity to the preceding impulse. The impulse thus transmitted will cause the electro-magnets applied to each pendulum to be simultaneously vitalized, and the pendulum will be impelled or attracted by the electro-magnet nearest which it chances to be. The action of the electro-magnet is to induce in the armature a polarization which is retained to a certain degree after the polarizing force has been removed. Continued polarization of the same character would result in establishing a permanent polarization of the armature, and thus impair the operation of the device. The succeeding impulse, being, however, of the opposite polarity, acts to reverse the polarization acquired and retained by the armature.

In the accompanying drawings, Figure 1 is a diagram showing an organization of circuits and apparatus illustrating my invention. Fig. 2 illustrates certain details in the construction of the synchronizing apparatus.

Referring to the figures, A represents a pendulum of a suitable standard clock or regulator, and B' B^2 B^3 represent suitable automatically-actuated clock-pendulums the movements of which it is desired to maintain in unison with the movements of the regulating-pendulum A. The pendulum A may, for convenience, be assumed to beat one-half seconds, the period of its complete vibration being one second. The pendulums B are constructed to vibrate, as nearly as practicable, in periods equal to that of the pendulum A.

Applied to the pendulum A is a circuit-closing device, C, of any suitable construction, adapted to transmit electric impulses alternately from the opposite poles of a battery, E, upon a main-line conductor, L. The conductor L extends throughout the stations at which the pendulums B are placed, and is connected at its remote terminal with the earth at G′, or with a return-conductor. The circuit-closer C, which I have shown, consists of an insulated pivoted lever, *c*, which is linked to the pendulum-rod *a* of the pendulum A, and which is caused by the vibrations of the pendulum to place a contact-point, *c′*, carried upon the short arm of the lever, alternately in electrical connection with two contact-springs, c^2 c^3. The springs c^2 and c^3 are respectively electrically connected by conductors 1 and 2 with the positive and negative poles of a battery, E. An insulated resting-contact, c^4, against which the springs c^2 and c^3 are normally held by virtue of their resilience, is electrically connected by a conductor, 3, with the earth at G, or with the return-conductor above referred to, as the case may be. The lever *c* is electrically connected with the main line L. When the contact-point *c′* is caused by the movement of the lever *c* to impinge upon the contact-spring c^2, that spring will be pressed away from the contact-point c^4, while the spring c^3 will remain in contact therewith. The circuit may be traced as follows:

from the earth at G, through conductor 3, stop c^4, spring c^3, to the negative pole of the battery E; from the positive pole of the battery, through the conductor 1, contact-spring c^2, arm c, and main line L, to the earth at G'. A positive impulse will thus be transmitted upon the line. When the lever c is actuated by the movement of the pendulum A in the opposite direction, the contact-point c' will impinge against the contact-spring c^3, pressing it away from the resting-contact c^4. The positive pole of the battery E will then be connected, through the conductors 1, spring c^2, resting-contact c^4, and conductor 3, with the earth at G, and the negative pole will be connected, through conductor 2, spring c^3, contact c', and lever c, with the main line L. In this manner alternate positive and negative electric impulses will be transmitted from the battery E upon the main line L at each vibration of the pendulum A. The duration of these impulses may be varied as desired by adjusting the position of the contact-springs c^2 and c^3 with reference to the contact-points c'. The parts are preferably so organized that an impulse will be thus transmitted only when the pendulum A is at one extremity or the other of its beat. The electric impulses thus transmitted upon the main line L are caused to traverse at each station the coils of two electro-magnets, m, applied to the pendulum B. The two electro-magnets m are respectively located near the opposite limits of the beat of the pendulum to which they are applied, and with their poles in close proximity to the arc described by a soft-iron armature, n, at the extremity of the pendulum. Thus the electro-magnet m' is placed at the left-hand limit of the beat of the pendulum B', and the electro-magnet m^2 at the right-hand limit. Likewise, electro-magnets m^3 and m^4 are located at the opposite extremities of the arc described by an armature, n^2, carried at the extremity of the pendulum B^2. The same organization is carried out with reference to the pendulum B^3 and any other pendulum which may be included in the system. Whenever an impulse is transmitted from the battery E upon the line L, the electro-magnets m will all be simultaneously vitalized. Such an impulse being transmitted only when the pendulum A is at or near one limit or the other of its beat, the influence of the electro-magnets m will cause the pendulums B to be simultaneously at the limits of their respective vibrations. So long as any pendulum—for example, the pendulum B'—is moving in unison with the regulating-pendulum A, the electro-magnets m' and m^2 will be vitalized only when the armature n' is at its nearest point, or opposite to the magnet m' or m^2, as the case may be. No appreciable effect will therefore be produced upon the pendulum. If, however, a pendulum, B^2, has fallen behind the pendulum A, and both pendulums are moving in the direction indicated by the arrow x^2, the electro-magnet m^4 will be vitalized before the pendulum B^2 has reached the limit of its vibration. The armature n^2 will therefore be attracted and the movement of the pendulum B^2 will be accelerated. The same operation will be repeated at the opposite limit of the vibration of the pendulum B^2 through the action of the electro-magnet m^3. The successive impulses thus imparted to the pendulum will ultimately bring it into unison with the regulator-pendulum. Should any pendulum chance to be slightly in advance of the regulator-pendulum, the operation will be the reverse of the above, each electric impulse acting to retard the movement of that pendulum. Another condition which may exist is that in which a pendulum, B, is swinging in the reverse direction from the regulating-pendulum. The successive electric impulses will in this instance act to maintain a synchronism in precisely the same manner as above described, the pendulums continuing to beat in opposition, but in unison as regards their periods. If but one electro-magnet m were employed, and that vitalized but once during each vibration of the pendulum, the tendency of this magnet would always be to establish a movement of the pendulum to which it is applied in a direction corresponding to that of the pendulum A. If, therefore, a pendulum, B, were started or ceased to swing half a vibration in advance of the regulator-pendulum, the electro-magnet would tend to exert a retarding influence upon that pendulum, thus ultimately causing it to stop. For this reason I prefer to employ the construction described, thereby preventing any possibility of stopping the movement of the pendulums B in whatever phase they may have been caused to swing.

As has already been stated, the impulses transmitted through the electro-magnets m are of alternate positive and negative polarity. The cores of any two electro-magnets m applied to a given pendulum should therefore be wound in the same direction, and the magnetism induced in the armatures n will then be reversed at each semi-vibration of the pendulum. By this construction the residual magnetism which would otherwise be retained by the armatures n is neutralized by each succeeding polarization. It is evident, however, that by winding the two electro-magnets which are applied to any pendulum in opposite directions and employing impulse from one pole only of the battery, a like result would be produced as regards the armature, since the poles of the electro-magnets which are presented to the respective ends of the armature are oppositely polarized. In this construction, however, each electro-magnet being constantly polarized by a current of the same character, its cores would acquire, to a greater or less extent, a permanent magnetization, and therefore impair the working of the apparatus.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a regulating-pendulum, a series of automatically-actuated pendulums, a battery and a main line, and means, sub-

stantially such as described, for transmitting electric impulses from said battery upon said main line, each of said automatically-actuated pendulums vibrating over a pair of electro-magnets included in said main line and located near the respective limits of vibration.

2. The combination, substantially as hereinbefore set forth, of a battery, means, substantially such as described, for periodically transmitting electric impulses of opposite polarity from said battery upon said main line, a series of automatically-actuated pendulums, and an armature applied to each of said pendulums, each of said armatures vibrating over a pair of electro-magnets included in said main line and located at the opposite extremities of vibration.

3. The combination, substantially as hereinbefore set forth, of a vibrating pendulum, an armature applied to said pendulum, two electro-magnets having their fields of force at or near the respective limits of the arc of vibration of said pendulum, and means, substantially such as described, for simultaneously vitalizing said electro-magnets, and for reversing the polarity of said electro-magnets t each vitalization.

4. The combination, substantially as hereinbefore set forth, of an automatically-actuated pendulum, an armature carried upon said pendulum, two electro-magnets, and means, substantially such as described, for simultaneously inducing in said electro-magnets magnetism of like polarity, and for reversing that polarity at each semi-vibration of said pendulum.

5. The combination, substantially as hereinbefore set forth, of a vibrating pendulum and armature carried at the extremity thereof, and means, substantially such as described, for inducing in said armature magnetism of opposite polarity at each semi-vibration of said pendulum.

In testimony whereof I have hereunto subscribed my name this 16th day of April, A. D. 1883.

VITALIS HIMMER.

Witnesses:

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