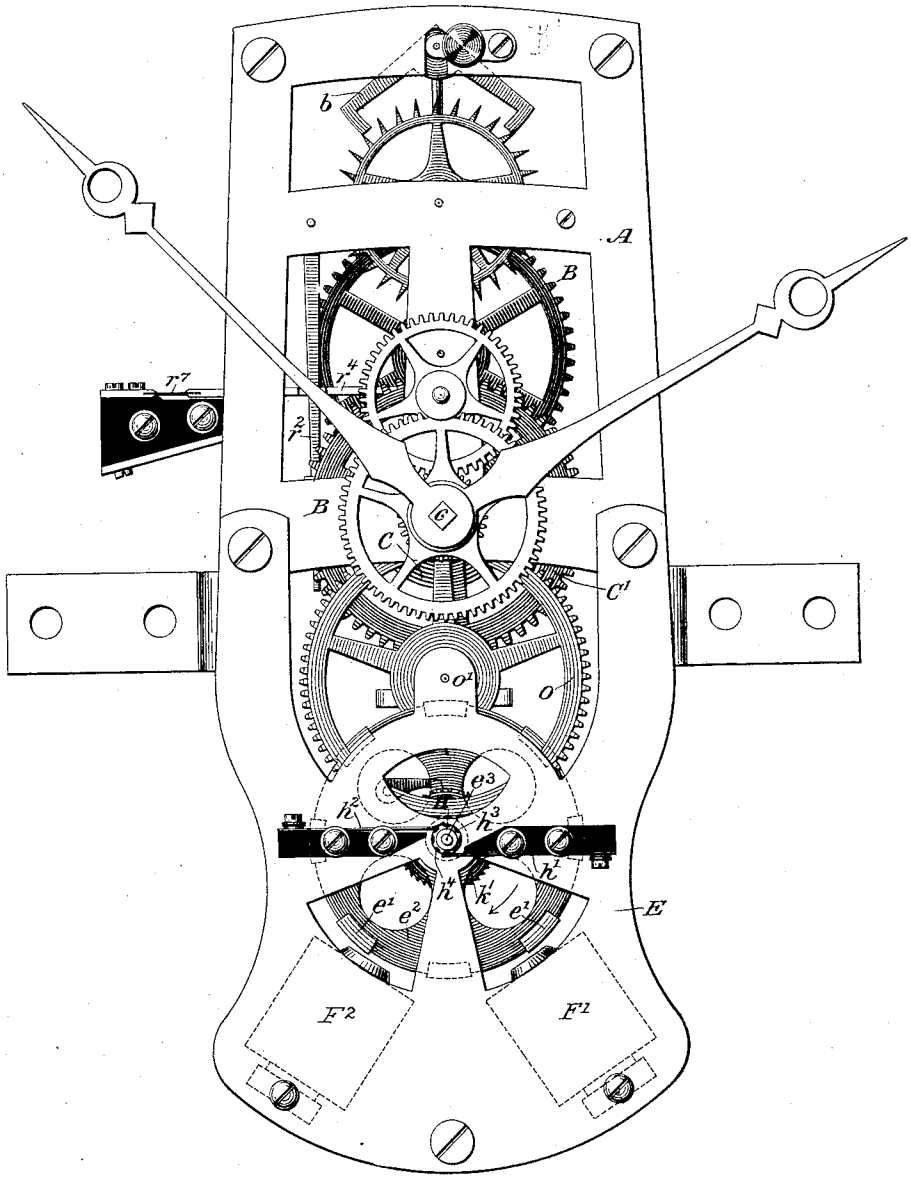
(No Model.) 3 Sheets—Sheet 1.

C. H. POND.

ELECTRO MECHANICAL CLOCK.

No. 308,521. Patented Nov. 25, 1884.

Fig. 1,



Witnesses

Wm A. Skinkle

Carrie E. Ashley

Inventor

Chester H. Pond,

By his Attorneys

Pope & Edgecomb

(No Model.)

3 Sheets—Sheet 2.

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Fig. 2.

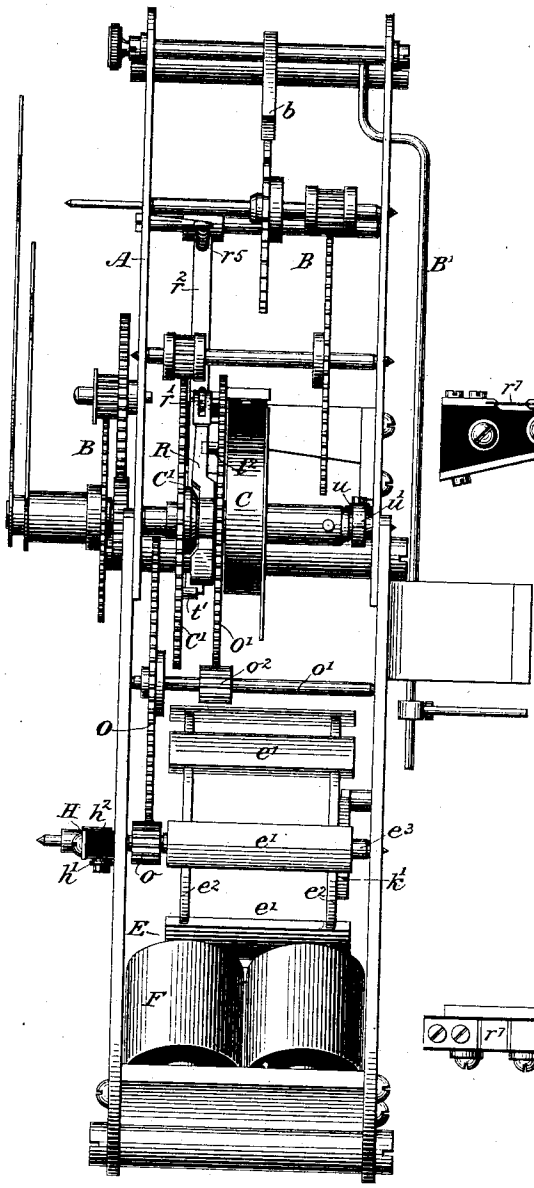


Fig. 3.

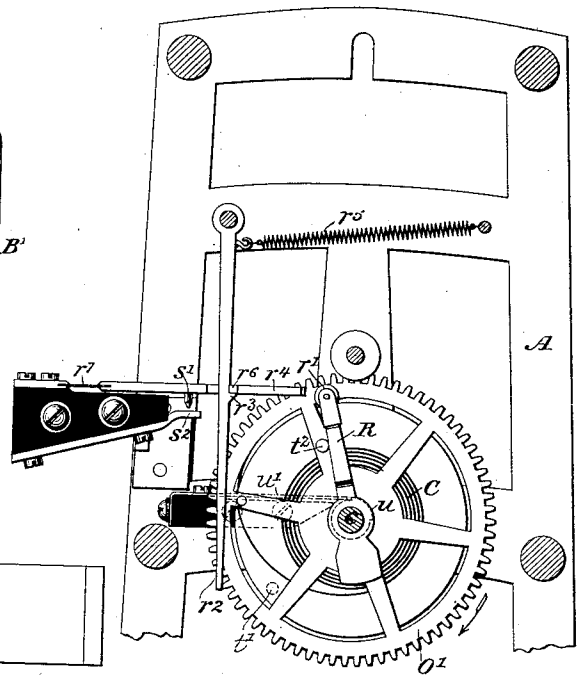
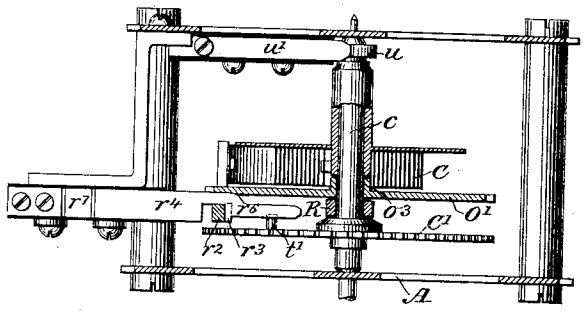


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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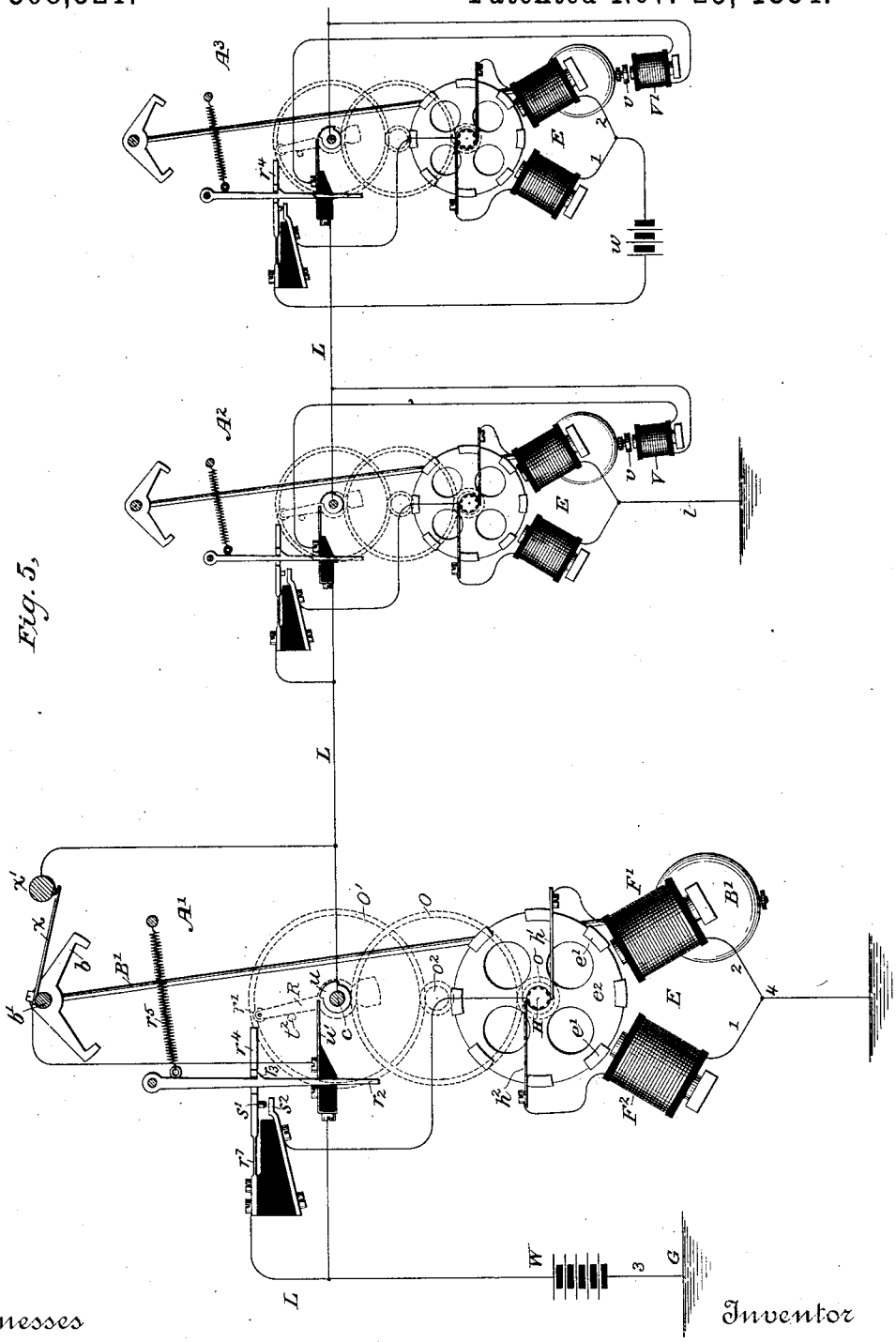

Fig. 5.

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UNITED STATES PATENT OFFICE.

CHESTER H. POND, OF NEW YORK, N. Y.

ELECTRO-MECHANICAL CLOCK.

SPECIFICATION forming part of Letters Patent No. 308,521, dated November 25, 1884.

Application filed September 30, 1884. (No model.)

To all whom it may concern:

Be it known that I, CHESTER H. POND, a citizen of the United States, residing in the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Electro-Mechanical Clocks, of which the following is a specification.

My invention relates to the class of electric clocks actuated directly by the force of a spring or a weight which is wound through the agency of electro-magnetism.

In organizing electric clocks and clock systems, it has usually been customary to propel each clock through the agency of a pawl or of an escapement, which in turn is actuated by an electro-magnet. Such an electro-magnet is caused to be periodically vitalized by the movements of the clock-train, or else by the operation of a primary regulator, which causes electric impulses to be transmitted to the several secondary clocks connected therewith at predetermined intervals—such, for instance, as once each second, or once each minute. When the clocks are thus actuated, the movements of the hands, instead of being constant and regular, as in the ordinary mechanical clock, are periodical. During the greater portion of the time, therefore, the hands of the clock are motionless or "dead." When a number of secondary clocks are driven or controlled by the movements of a primary clock, they are liable to be stopped or a portion of them to be thrown out of synchronism by any accident to the primary clock or to the main conductor of the system. Again, the uniform movements of the hands of such clocks as are operated by electro-magnets vitalized at frequent intervals, requires that the battery strength shall at all times be sufficient to drive the pawls and move the hands; otherwise one or more of the clocks of a system will fall behind the regulator.

To provide a clock and a clock system which shall be free from these and other incidental defects is the object of this invention.

It has been heretofore proposed to actuate clocks by a spring or a weight maintained under tension, or wound by means of an electro-magnet and a pawl actuated by the armature of the same at frequent intervals. The expenditure of energy in such organization is considerable, and owing to the frequent movements of the armatures the movement of the mechanism is more or less unreliable.

This invention is based upon the employment, in connection with an ordinary clock-movement which is driven by a spring or weight, of an electro-magnetic motor which periodically winds the spring or weight. Each clock is constructed in such a manner that it may operate independently of other clocks, or may be one of a series controlled by a central clock. The spring or weight is preferably of such capacity that it will serve to actuate the clock for several hours without rewinding. At the commencement of each hour, or at some other predetermined interval, the clocks, if there are several clocks in a system, are placed in such condition as to have their springs or weights successively wound without causing a cessation in the driving force which each spring exerts upon its train of wheels. After the springs or weights are wound to a predetermined tension or limit the normal conditions of each clock are re-established. The motor employed for winding each clock may be any suitable form of rotary electric motor, whether dynamo or magneto electric. It will be apparent that during the greater portion of each hour there will be no occasion for employing the battery force for winding the clocks. During such time it is designed that the main conductor of the system shall have its circuit connections through a series of synchronizing-magnets, which are respectively applied to the several clock-pendulums, or to some other suitable portion of the clock mechanism. Suitable means are provided in case the magnets are applied to the pendulums for sending an impulse from the battery through these magnets once during each complete or each semi-vibration of the pendulums. These impulses serve to maintain the several clocks synchronized in a manner well understood. It will be understood that the synchronizing-magnets may be applied to the hands of a clock, if it is desired.

In the accompanying drawings, which illustrate the invention, Figure 1 is a front elevation of the mechanism of the clock, the face being removed. Fig. 2 is a side elevation of

the same. Fig. 3 is a vertical transverse section of a portion of the instrument. Fig. 4 is a plan section of the same portion of the mechanism. Fig. 5 is a diagram illustrating the organization of the clocks in a system.

Referring to the drawings, A represents the frame of the clock, and B the train of wheels commonly employed for actuating the hour, minute, and second hands in the usual manner. The train B is normally impelled by means of a spring, C, acting through a center wheel, C′, carried upon an arbor, *c*. The spring C is preferably of such length that it is capable of actuating the clock for several hours. An escapement-anchor, *b*, serves to control the movements of the train, and a vibrating pendulum, B′, controls the movements of the escapement in the usual manner.

The spring C is designed to be wound once each hour, or at some other convenient predetermined interval, by means of an electric motor, E. This motor is designed to be set in operation in a manner which will be hereinafter described, and to wind the spring quickly to a predetermined tension. The motor consists, preferably, of a series of armature-bars, *e′*, of soft iron, which are mounted upon suitable non-magnetic disks or rings, e^2 e^2. These rings are supported from the axis e^3 of the motor. Two or more electro-magnets, F′ and F², are employed for propelling the armature in the direction of the arrow. These two electro-magnets are alternately placed in circuit with a battery, W, through the agency of a commutator, H, and its two brushes, *h′* and h^2. During the revolution of the shaft of the motor these brushes are alternately brought into contact with conducting and non-conducting segments h^3 and h^4 of the commutator. The battery W has one pole connected with the earth at G by a conductor, 3. Its other pole is connected with the conducting-segments of the commutator through a circuit-controlling device, which will be hereinafter described. The two brushes are respectively connected with one terminal of the coils of each of the two electro-magnets. The remaining terminals of these coils are connected with each other by conductors 1 and 2 at a point, 4, and this point is connected with the outgoing main conductor or with the earth. A ratchet-wheel, *k′*, is carried upon the shaft e^3 of the armature of the motor, and a pawl resting against this wheel prevents the armature from turning backward.

Upon the shaft e^3 of the armature there is carried a pinion, *o*, which engages the teeth of a wheel, O. The shaft *o′* of the wheel O carries a pinion, o^2, and this pinion engages the teeth of a gear-wheel, O′. The collet or sleeve o^3 of wheel O′ loosely surrounds the arbor *c* of the center wheel, C′, of the train. The spring C has one end attached to the arbor *c*, and its other end is secured to the wheel O′. When, therefore, the motor is set in operation, the wheel O′ is driven in the direction of the arrow, and the spring is wound from its outer end. The spring is constantly unwound from its inner end by the action of the escapement of the clock, and it is evident that during the winding of the spring by the motor the clock will continue to be driven. It may be here remarked that a great advantage over the winding device operated by the to-and-fro movement of an armature is derived from the employment of the rotating armature of an electric motor, for the reason that the momentum acquired by such an armature is availed of in the winding, whereas in the case of a vibrating armature this factor is entirely lost.

The method of setting the motor in operation will now be described. Loosely mounted upon the arbor *c* is a balanced arm, R, which is designed to operate a circuit closing and opening device once each hour. The arm R carries at one end a small roller, r', which is designed to be carried against the lower end of a pendent arm, r^2, when the clock is to be wound. The pendent arm r^2 carries a hook or catch, r^3, which normally engages a circuit-closing arm, r^4. The pendent arm r^2 is normally held in the position to engage the arm r^4 by a spring, r^5. When, however, the roller r' at the end of the arm R is forced against the pendent arm r^2, the latter is forced backward against the tension of the spring r^5, and the catch r^3 is moved out of the path of the shoulder r^6 on circuit-closing arm r^4. The latter is then pressed downward by the action of a spring, r^7. When the circuit-closing arm r^4 is thus released, a contact-point, *s′*, carried thereon, is brought against a corresponding insulated point, s^2, supported from the frame A. These two points are respectively connected with the main conductor L and with the conductor leading to the commutator-segments. The circuit of the motor will therefore be completed as soon as the arm R has caused the arm r^4 to be released, and its armature be thereby put in motion. For the purpose of thus operating the arm R a pin, *t′*, is caused to project laterally from the face of the center wheel, C′, of the clock-train. This wheel revolves once an hour and the pin will therefore, by engaging the arm, cause it to be forced against the pendent arm r^2 once in each hour. The circuit will be completed thus at a predetermined moment; but it is evident that the slow movement of the center wheel, C′, cannot be relied upon for interrupting the circuit, for it is desirable that when the spring is wound the circuit through the motor should be interrupted immediately. For this reason there is placed upon the wheel O′ a pin, t^2, which, like the pin *t′*, projects laterally from the face of the wheel toward the arm R.

As already described, the operation of the motor is to turn the wheel O′ in the direction of the arrow. The pin t^2 will therefore be caused to overtake the arm R and cause it to advance rapidly from the pin *t′* and the arm r^2 into engagement with the circuit-closing

arm r^4. The latter is lifted, causing the contact-points to be separated, and the catch r^3 again passes into engagement with the circuit-closing arm r^4. The arm R then remains at rest until the pin t' is caused, by the revolution of the center wheel, C', to again overtake and to gradually advance it, thus causing the operation to be repeated. The operation of the motor is exceedingly rapid, and it usually requires about seven seconds only to wind the spring sufficiently to actuate the clock an hour. It will be understood that the spring is intended to be normally wound sufficiently to actuate the clock for several hours, even though the motor is not actuated.

When several clocks are connected in series, it is designed that the conductors 1 and 2 leading from the coils of the electro-magnets of the motors shall be connected with the earth. At the commencement of each hour the circuit connections of the main line will therefore be completed from the battery W, one pole of which is connected with the earth, as shown in the diagram Fig. 5, through the main conductor L, and with the earth through the several motors, E, and corresponding conductors, *l*. It is evident, however, that although the several motors are placed in circuit in multiple arc, yet, owing to the resistance of the main line, the motor nearest the battery will be first actuated. The ground-connection of this motor being then interrupted the next motor will be operated, and so on throughout the series. The time required for all the clocks in a system to be thus wound will usually be considerably less than a quarter of an hour, even in very extended systems. During the remaining three-quarters of an hour, therefore, the battery will not be required for the purpose of actuating the motors, and during such time it may be desired to employ the battery and main conductor for synchronizing the clocks. For this purpose there is placed upon the arbor *c* of each clock a cam, *u*, which extends over one quarter of the circumference of the arbor. A circuit-closing arm, *u'*, is applied to this cam. When the cam is resting against the arm *u'*, the main-line circuit is completed from the arm, which is connected with the main line through the cam which is in electrical connection with the succeeding section of the main line—that is to say, with the section leading to the next clock. The parts are so adjusted that the several clocks will thus place the main line in connection with the motor-controlling devices simultaneously. During three-quarters of each hour, therefore, the connections of the main line are through the synchronizing-magnets; but when the cams make contact with the respective arms the corresponding synchronizing-magnets will be shunted. The main-line connections are therefore at all times complete, either through the synchronizing-magnets or through the shunts of the magnets. The electro-magnets V are respectively applied to armatures *v*, carried upon the respective pendulums of the clocks. These electro-magnets are designed to be vitalized as the armatures pass above their poles for the purpose of synchronizing the pendulums in a manner well understood. The impulses which are required for thus vitalizing the electro-magnets may be derived from the battery W by the action of a circuit-closing device applied to one of the clocks of the series. Thus there may be applied to the trunnion *b'*, carrying the escapement-anchor of one of the clocks, a circuit-closing arm, *x*. This arm is caused, by the movement of the anchor in one direction, to impinge against a contact-point, *x'*, at the limit of its movement. The arm *x* is connected in this clock with the arm *u'*, and the point *x'* is connected with the section of the main line leading to the line of clocks. In this manner synchronizing impulses will be sent to all the clocks in the series by the action of one of the clocks, which shall be maintained at standard time.

It remains to describe the method of actuating the motors of one or more clocks in the series independently of the other motors. This is illustrated in the diagram Fig. 5 in connection with the clock A^3. In this instance a small independent battery, *w'*, is employed. The connections of this battery are completed at the proper intervals through the electric motor in the manner already described, one pole of the battery being connected with the circuit-closing arm r^4, and the other with the conductors 1 and 2. A synchronizing electro-magnet, V', is applied to the pendulum of this clock for the purpose of causing it to maintain uniform time with the other clocks in the system. This magnet is included in the main line in the usual manner. It is desirable, however, that this magnet should be shunted during the time the other clocks are being wound. For this reason the section of the main conductor leading to this clock is connected directly with the contact-arm *u'*, and this arm is also connected through the coils of the electro-magnet with the succeeding section of the main line in the usual manner. The cam *u* is also connected directly with the succeeding section of the main conductor, and when the cam makes contact with the arm the synchronizing magnet is shunted. It is evident that this clock A^3 may thus be actuated independently of the other clocks in the system while maintained in synchronism therewith. The same organization may be applied to other clocks in the system.

The clocks may, it is evident, be actuated at any other periods than once an hour, if it is so desired.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a mechanical clock-train, an electric motor having continuous movement, an intermediate train, and means, sub-

stantially such as described, for periodically setting said motor in operation and winding said mechanical clock.

2. The combination, substantially as hereinbefore set forth, of a mechanical clock mechanism, an electric motor having a rotating armature, and an intermediate train of wheels for causing the movements of said motor to wind the spring of said clock.

3. The combination, substantially as hereinbefore set forth, of a clock mechanism and an electric motor having a rotating armature for winding the spring or weight of said clock mechanism.

4. The combination, substantially as hereinbefore set forth, of a clock mechanism, an electric motor having continuous movement for periodically winding the same, and means, substantially such as described, for preventing a retrograde movement of said motor.

5. The combination, substantially as hereinbefore set forth, of a clock mechanism, a rotating electric motor, means, substantially such as described, for periodically actuating said motor and causing it to wind the spring or weight of said clock mechanism, a synchronizing-magnet applied to said clock mechanism, and means, substantially such as described, for vitalizing said magnet from the same source of electricity as is employed for actuating said motor.

6. The combination, substantially as hereinbefore set forth, of a clock mechanism, a main conductor, a rotating electric motor, a synchronizing electro-magnet, and circuit-controlling devices serving to normally complete the connections of said main conductor through said synchronizing-magnet, but at predetermined periods to connect the same with said motor.

7. The combination, substantially as hereinbefore set forth, with a time-train and a spring or weight for actuating the same, of a rotating electric motor for winding the same, a circuit-closing device for completing the connections of an electric circuit through said motor at predetermined intervals through the action of said time-train, and means for interrupting said circuit through the action of said motor.

8. The combination, substantially as hereinbefore set forth, with a time-train and a spring or weight for actuating the same, of an electric-motor for winding said spring or weight, and a circuit-controlling device for periodically completing and interrupting the connections of an electric circuit through said motor, which device consists of an arm loosely surrounding one of the arbors of said train, a pin moving with said arbor, which pin engages said arm, a lever against which said arm is caused to impinge at one point in its revolution and to thereby cause said circuit to be completed, and a pin moving with said winding device, which pin engages said arm and advances it from engagement with said lever into engagement with a second lever or arm, thereby causing said circuit to be interrupted.

9. In an electric-clock-winding device, the combination, substantially as hereinbefore set forth, of the arm R, the wheels C′ and O′, the pins t' and t^2, for engaging said arm, the pendent arm r^2, and the circuit-closing arm r^4.

10. In an electric winding device for clocks, the combination, substantially as hereinbefore set forth, of the motor E, the wheels C′ and O′, arbor c, the arm R, mounted loosely upon said arbor, means, substantially such as described, for advancing said arm first through the movement of the wheel C′ and subsequently through the movement of the wheel O′, and the circuit-controlling device which is operated to close an electric circuit through said motor when said arm has been advanced by the wheel C′, and to interrupt the same when it is advanced by the wheel O′.

11. The combination, substantially as hereinbefore set forth, in an electrical device for winding clocks, of a motor, a circuit-controlling device, and means, substantially such as described, for causing said device to complete an electric circuit by the action of the clock, and to interrupt the same by the action of the winding device.

12. The combination, substantially as hereinbefore set forth, of a time-train, a rotating electric motor for winding the same periodically, a battery for actuating said motor, a circuit-controlling device actuated by said time-train, a synchronizing electro-magnet, a shunt-circuit around said magnet the connections of which are periodically completed by said circuit-controlling device, a circuit-controlling device for said motor, and means for operating the last-named device while said synchronizing magnet is shunted.

13. The combination, substantially as hereinbefore set forth, of the time-train, the synchronizing-magnet, the electric motor for winding said time-train periodically, the circuit-controlling device for the same, and means, substantially such as described, for shunting said synchronizing-magnet while said motor is actuated.

14. The combination, substantially as hereinbefore set forth, of a series of clocks, a battery, a conductor leading from said battery to said clocks, a motor in each of said clocks for winding the same, and means, substantially such as described, for completing a circuit through all of said motors from said main line, and causing said clocks to be successively wound by the action of the same.

15. The combination, substantially as hereinbefore set forth, of a series of clocks, a motor in each of said clocks, said motors being arranged in multiple arc, a battery, a conductor leading from said battery to said clocks, and means for simultaneously placing said motors in connection with said battery at predetermined times.

16. The combination, substantially as here-

inbefore set forth, of a battery, a main conductor, a series of clocks, a motor in each of said clocks for winding the same, a synchronizing electro-magnet applied to each of said clocks and included in said conductor, and a shunt-circuit around each of said magnets the connections of which are automatically completed at predetermined times.

17. The combination, substantially as hereinbefore set forth, of a source of electricity, a series of clocks, a rotating electric motor in each of said clocks for winding the same, and a conductor leading from said source to each of said motors.

In testimony whereof I have hereunto subscribed my name this 22d day of September, A. D. 1884.

CHESTER H. POND.

Witnesses:
DANL. W. EDGECOMB,
CHARLES A. TERRY.