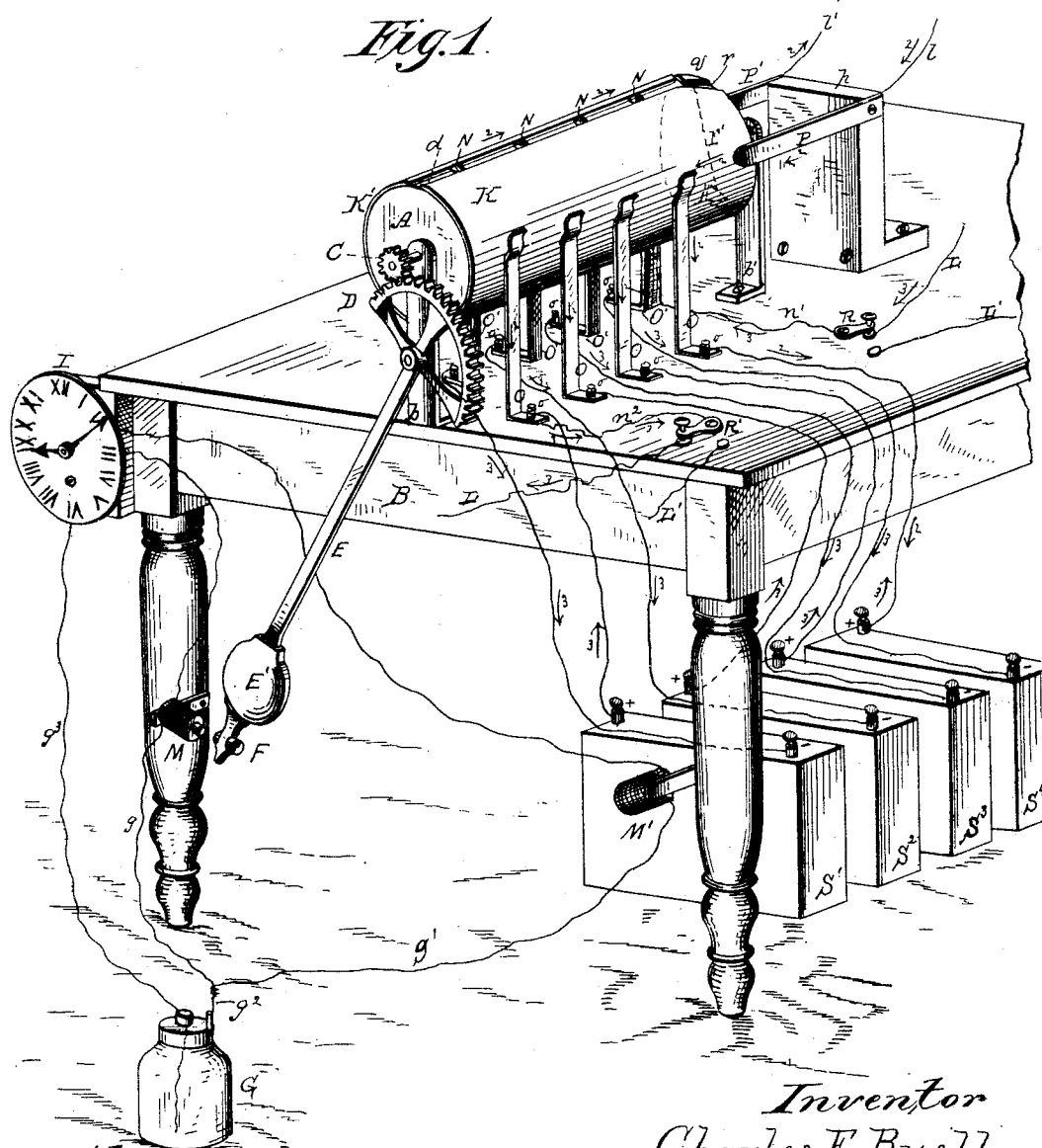


C. E. BUELL.

TIME SWITCH FOR SECONDARY BATTERIES.

No. 403,177.

Patented May 14, 1889.



Witnesses,
J. L. Oursand
Geo. A. Byington

Inventor
Charles E. Buell,
by *Reverie Church*
Attorney.

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Fig. 2.

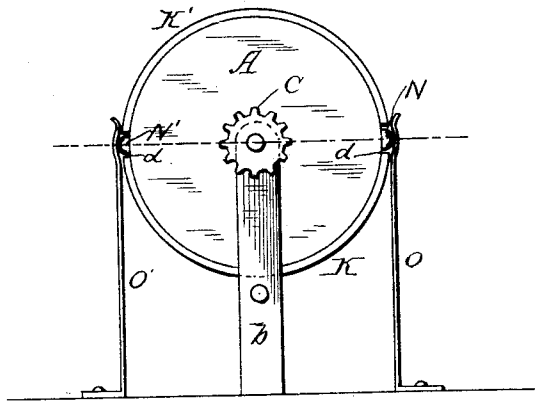


Fig. 3.

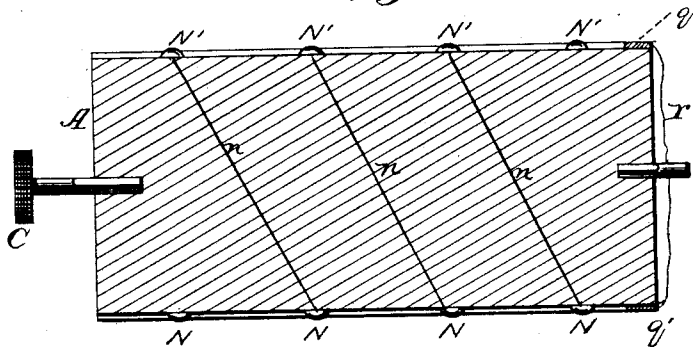
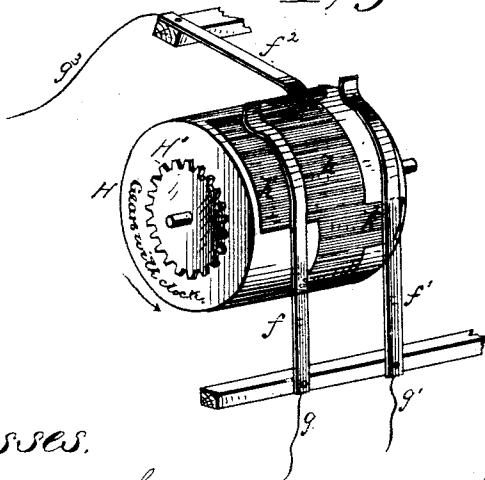


Fig. 4.



Witnesses.

P. L. Ourand

Phil. Whale

Inventor

Charles E. Buell.

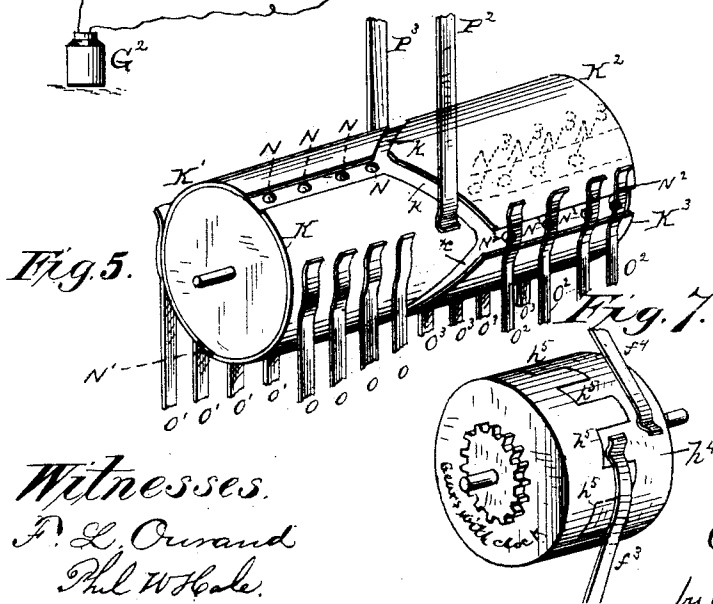
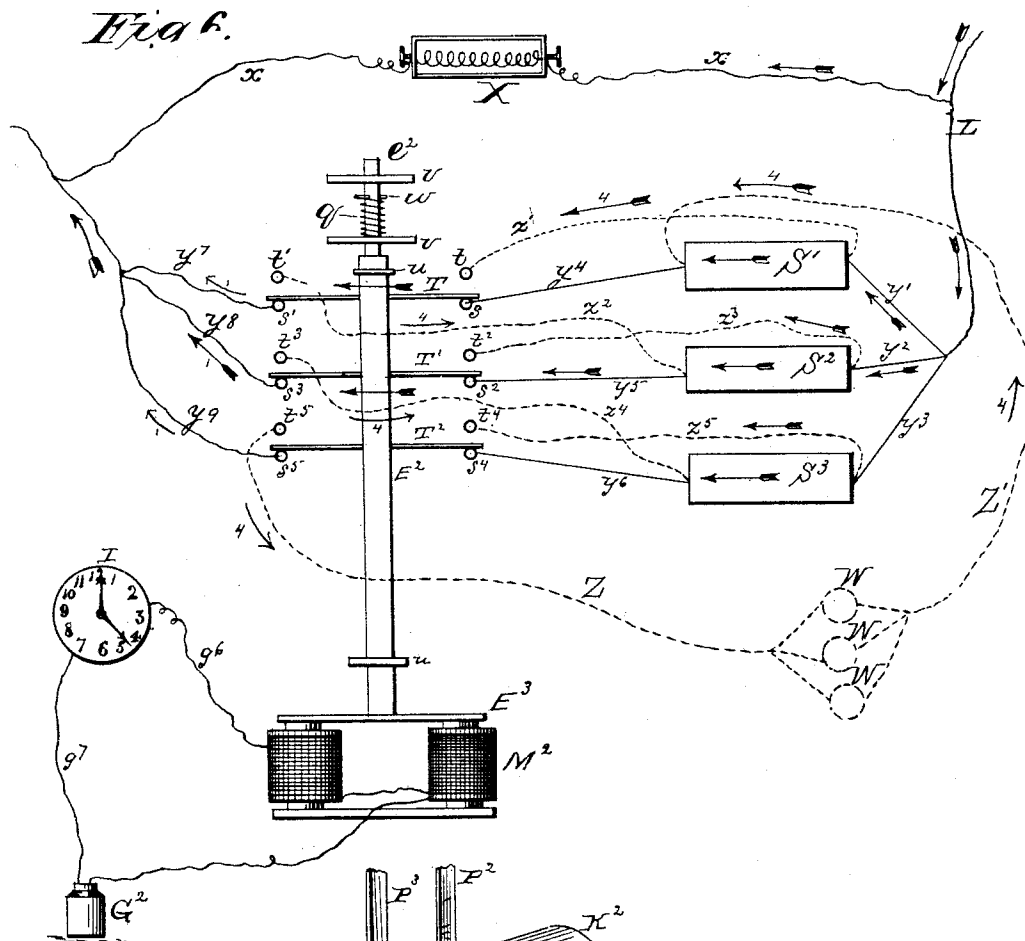
By Keewille Church
attorney.

C. E. BUELL.

TIME SWITCH FOR SECONDARY BATTERIES.

No. 403,177.

Patented May 14, 1889.



Witnesses.

F. L. Orin and
Phil W. Hale.

Inventor

Charles E. Buell,
by *Herbille Church*
Attorney.

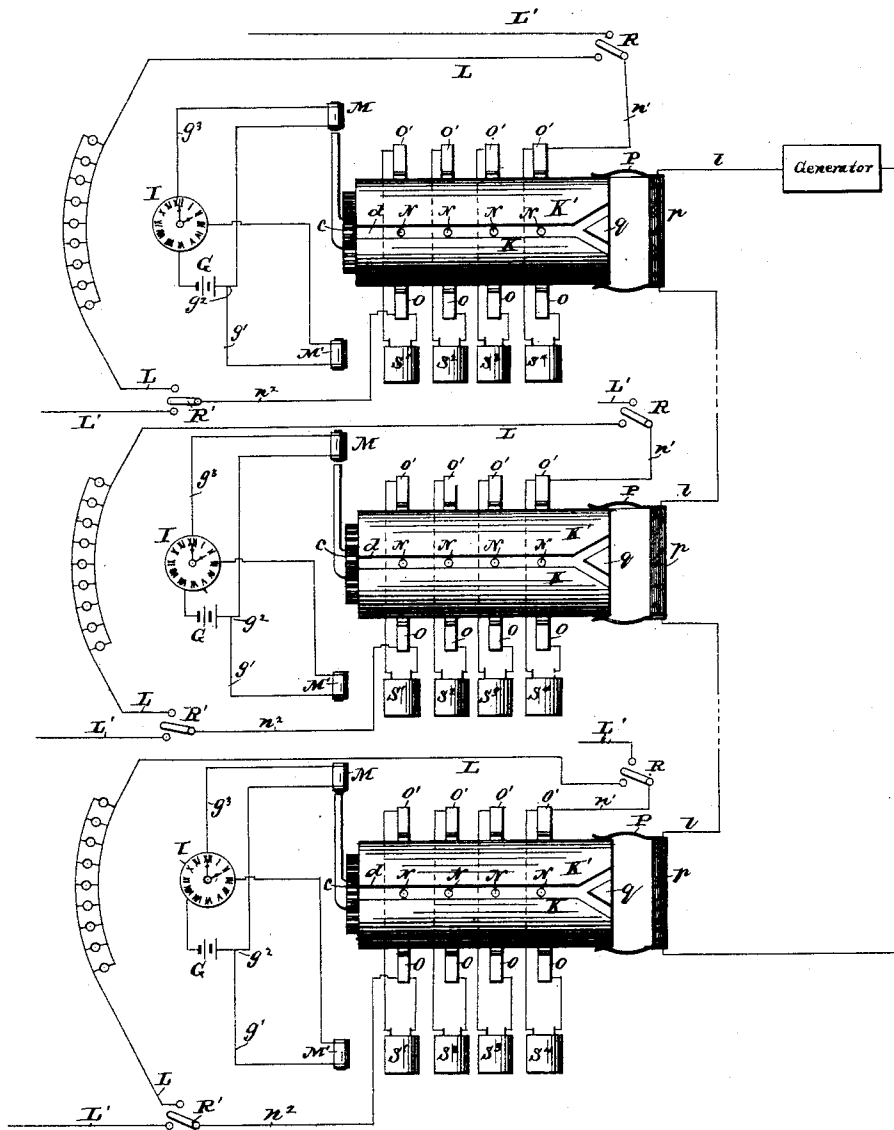
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Fig. 8.



Witnesses.
 Chas. R. Buell.
 J. B. Church

Inventor:
 Charles E. Buell
 by Melville Church.
 his Attorney

UNITED STATES PATENT OFFICE.

CHARLES E. BUELL, OF NEW HAVEN, CONNECTICUT.

TIME-SWITCH FOR SECONDARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 403,177, dated May 14, 1889.

Application filed November 15, 1881. Serial No. 45,423. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. BUELL, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Time-Switches for Secondary Batteries; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

The object of this invention is to automatically, at predetermined periods, connect one or more series of secondary electric batteries alternately with a charging-circuit in multiple arc and with a working or discharging circuit in tension series.

To this end the invention consists in a novel construction of switching devices and the combination, with the same, of a controlling time mechanism, as will be hereinafter particularly described, with reference to the accompanying drawings, in which—

Figure 1 is a perspective view of my automatic time-switch. Fig. 2 is a view showing the end of the switch-cylinder and two of the spring contact-fingers. Fig. 3 is a longitudinal section of the cylinder, showing the connection of the contact-buttons. Fig. 4 is a perspective view of the circuit breaking and closing cylinder operated by time mechanism. Fig. 5 is a view illustrating the arrangement of a switch for two series of secondary batteries. Fig. 6 is a diagram illustrating a modification of the switch. Fig. 7 is a perspective view of a modified form of circuit breaking and closing clock-cylinder for use with the form of switch shown in Fig. 5. Fig. 8 is a view showing a system consisting of two or more stations, each embodying an apparatus similar to that in Fig. 1.

Referring to Fig. 1, the letter A indicates a cylinder of non-conducting material, provided at its opposite ends with journals having bearings in standards *b* and *b'*, respectively. Upon the end of the journal which projects through the bearing in standard *b* is fixed a pinion, C, which gears with a segmental rack, D, fixed to the upper end of a pendu-

lum, E, which is pivoted to the standard below said pinion, the pivot being the center of a circle of which the rack is a part. It will be seen that when the pendulum oscillates on its pivot, an oscillating or rocking motion will be communicated to the cylinder A.

Upon the pendulum, near its lower end, is fixed a bob, E', of such weight that the pendulum will always swing promptly toward a vertical position when free, and vibrate in the usual manner. Below the weight or bob E' the pendulum carries an armature, F, preferably of soft iron, and fixed upon two opposite legs of the table B, which supports the standards, are two electro-magnets, M and M', each having its poles arranged in the path of the armature as the pendulum swings. The coils of these magnets are connected, respectively, in the branches *g* and *g'* emanating from the wire *g*², which forms part of the circuit of a galvanic battery, G.

The branches *g* and *g'* terminate in metallic spring-fingers *ff'*, (shown in Fig. 4), which bear upon the periphery of a cylinder, H, of non-conducting material, which is fixed upon an arbor of the train of a clock, I, and the wire *g*², forming the other part of the battery-circuit, terminates in a metallic spring-finger, *f*², bearing upon a metallic band, *h*, which encircles said cylinder about its middle. From this metallic band *h* metallic plates *h'* and *h*² project laterally in opposite directions, and are curved to correspond with the periphery of the cylinder. The plates *h'* form arcs three times as long as those formed by the plates *h*², the former coming under and in contact with the finger *f* as the cylinder H is turned, and the latter forming contact with the finger *f'* in turn as the contact of finger *f* with a plate *h'* is broken.

It will be seen that when the finger *f* is in contact with a plate *h'* the battery-circuit will be completed through the wire *g*², branch *g*, magnet M, finger *f*, plate *h'*, band *h*, finger *f*², and wire *g*², and magnet M will be charged, so that if the pendulum be swung so that its armature is in attracting distance of the poles of the magnet M it will be caught and held by the magnet as long as the finger *f* and plate *h'* are in contact.

The arbor upon which the cylinder H is mounted carries a gear-wheel, H', which may

be geared in with the clock in the ordinary manner to make a complete revolution in any desired length of time. Suppose the said wheel and the cylinder H to be arranged to make a complete revolution in eight hours, and that the plate h' occupies three-fourths of the periphery of the cylinder, and the plate h^2 one-fourth. Then the finger f being in contact with plate h' and the armature against the poles of magnet M, the pendulum will be held inclined toward said magnet for six hours, at the end of which time the plate h' passes from under finger f , and the plate h^2 comes under finger f' . The circuit through branch g and magnet M will be broken, and the circuit through branch g' and magnet M' will be closed, and the latter magnet charged. The armature will be released by magnet M and the pendulum will swing by gravity toward magnet M', the armature being seized by the poles of said magnet and held as long as the finger f' remains in contact with the plate h^2 , which will be two hours, at the end of which time the armature will be released, the pendulum swung back to magnet M, and be held there for six hours, as before.

The wheel H' and cylinder H may of course be arranged to make their revolutions in any desired length of time, and the plates h' and h^2 may be proportioned as desired.

The curved surface of the cylinder A is nearly covered by two curved metallic plates, K and K', embracing opposite sides thereof and having their adjacent edges separated by intervening spaces d . In each of these spaces d is arranged a series of metal buttons or knobs, as shown at N and N', the buttons or knobs of one series being respectively directly opposite those of the other series, and the buttons or knobs of the two series are connected in pairs by metallic wires n , lying obliquely through the cylinder, so that each button N is not connected with a directly-opposite button N', but with one obliquely opposite or one space nearer one end of the cylinder, this arrangement being for a purpose which will presently appear.

Arranged upon the base or table B, on opposite sides of the cylinder A, are series of upright metallic spring-fingers O and O', the inner faces of which near their tops are curved and bear against the surface of the plates and buttons on the cylinder as it rotates. The lower portions of the fingers O and O' are bent to form feet, which are secured to the base or table B, and have binding-posts o mounted upon them.

The numbered letters S designate a series of secondary electric batteries, which may be of any suitable construction, and the positive + of said secondary batteries are connected by suitable wires with the binding-posts of the fingers O, and their negative poles - are similarly connected with the binding-posts of the fingers O'.

The letters P and P' denote metallic springs supported by an insulating-block, p , and hav-

ing their free ends bearing upon opposite sides of the end of the cylinder A, so that as the cylinder rotates the tips of said springs will be alternately in contact with the plates K and K' and with the small plates q' and q , arranged between said plates K and K', near the rear end of the cylinder, and separated therefrom by narrow oblique spaces r . These plates q and q' are connected by a wire, r' . (Shown in dotted lines across the rear end of the cylinder.) From the spring P a wire, l , leads to the positive pole of a primary charging electric generator, (not shown in the drawings,) and from the spring P' a wire, l' , leads to the negative pole of said generator.

From the rear end finger of the series of fingers O' a wire, n' , leads to a hand-switch, R, arranged to connect said wire with either of two circuits, the terminals only of which are indicated by the wires L and L', and from the front end finger of the series of fingers O a wire, n^2 , leads to another hand-switch, R', arranged to connect said wire with either of said circuits.

The operation of the apparatus now described is as follows: We will suppose the time occupied in charging the secondary batteries to be six hours, and that their current is applied to use for the space of two hours over either of the circuits L or L', in which may be included any apparatus adapted for operation by dynamic electricity, such as secondary batteries furnish. The clock-work is wound up in the ordinary manner and regulated to cause the cylinder H to make one complete revolution in eight hours in the direction indicated by the arrow, and said cylinder is set to start with the finger f bearing upon the plate h' as if it had just come in contact therewith. The pendulum being swung so that its armature is in contact with the poles of magnet M, the cylinder A is held in a corresponding position with the buttons N and N' as if they had just passed out of contact with fingers O and O', as shown in Fig. 1, said fingers bearing upon the plates K and K', with which they will remain in contact for six hours. At the end of that period the plate h' of the cylinder H will pass from under finger f , and the plate h^2 will come in contact with the finger f' , changing the circuit from magnet M to magnet M', as before explained. The pendulum will then be released by the magnet M, and swing to and be caught by magnet M', thus turning the cylinder A, so that the buttons N and N' will strike the fingers O and O' and raise them off the plates K and K', as shown in Fig. 2, said buttons remaining in contact with the curved faces of the fingers for the space of two hours, at the expiration of which time the plate h^2 of cylinder H will pass out of contact with finger f' , and the plate h' come again in contact with the finger f , so that the pendulum will be released by the magnet M', and swing over and be caught by the magnet M, the fingers O and O' being thus again brought into contact

with the plates K and K'. While the fingers O and O' are in contact with the plates K and K' the electric current from the primary generator flows over the wire *l*, as indicated by the arrows No. 2, to the spring P, thence to the plate K, and from said plate follows the spring-fingers O, and connecting-wires to the positive poles + (in the present instance) of the secondary batteries, and, passing through said batteries, leaves their negative poles -, passes over the connecting-wires to the spring-fingers O', and thence to the plate K', spring P', and wire *l'*, back to the primary generator. The current will thus flow through all the secondary batteries, charging them for the space of six hours, at the end of which time, as before described, the buttons N and N' strike the fingers O and O', as shown in Fig. 2. In this position the cylinder will have so turned that the plates K and K' have passed out of contact with the springs P and P', and said springs will bear upon the plates *q* and *q'*. The charging-circuit is not broken by this change of position of the cylinder, as the plates *q* and *q'* are connected by the wire *r'*, and the springs P and P' make contact with said plates before their contact with the plates K and K' is broken. The wire *r'* should preferably include a resistance (not shown in the drawings) equal to that of one of the secondary batteries, in order that the resistance in the charging-circuit may not be varied by its disconnection from the secondary batteries, and said circuit may be used for other purposes besides charging said batteries. For instance, it may be used as a fire-alarm or telegraph circuit. When the buttons N and N' come in contact with the fingers O and O', the secondary batteries will be connected in tension series, as will presently appear. Supposing the switches R and R' to connect the wires *n'* and *n²* with the circuit L, the current of the secondary batteries will flow as follows, to wit: From the positive pole of the battery S⁴ in the direction of the arrows No. 3 to its connected spring-finger O; thence to a button, N, over an oblique wire, *n*, to a button, N', and thence over a finger, O', to the negative pole of battery S³, through said battery and from its positive pole to the finger O, connected therewith, and thence, in the same manner, through all the secondary batteries, the currents of all of which join and pass off as a dynamic current from the positive pole of battery S' to the binding-post of its connected spring-finger O, and thence over the wire *n²* and switch R' to the line L. Traversing the line L the current reaches the switch R, and flows over wire *n'* to the spring-finger connected thereto, and which is also connected with the negative pole of battery S⁴. It will be understood that any apparatus adapted for operation by dynamic electricity may be interposed in the circuit L and operated by the current of the secondary batteries; or by means of the switches R and R' the current may be directed over the

circuit the terminals of which are indicated by L'. At the end of two hours the plate *h²* of clock-cylinder H will pass from under finger *f'*, the circuit through branch *g'* will be broken, the pendulum released and swing to magnet M. The buttons N and N' will leave the fingers O and O', said fingers coming in contact with the plates K and K', the secondary batteries being again connected with the charging-circuit in multiple arc, and the charging will continue for six hours, as before, at the end of which time the buttons N and N' will come again in contact with the fingers.

In Fig. 5 I have shown a switch-cylinder provided with two sets of plates and contact-buttons, so arranged that two series of the secondary batteries may be alternately connected with a charging-circuit and a working-circuit—that is, while one series is connected with the charging-circuit the other will be connected with the working-circuit. The two plates K and K' are so arranged that the buttons N and N' will stand at right angles to the buttons N² and N³, which are between the edges of the plates K² and K³, and while the spring-fingers O² and O³ are in contact with the plates K² and K³ the fingers O and O' will be in contact with the buttons N and N', respectively. The adjacent ends of the plates K K' and K² K³ lap past each other somewhat, and are separated from each other by narrow oblique spaces, as shown at *k*. The charging-circuit contact-springs P² and P³ bear against opposite sides of the cylinder at its middle, and in such position that when their tips are in contact with one set of the cylinder-plates a quarter-revolution of the cylinder will shift said plates out of contact, and bring the other set in similar contact with said springs. From the construction of this switch it will be readily understood that by the changing of the contact of the plates and springs P² and P³ two series of secondary batteries may be alternately connected with the charging-circuit, and that these two series of batteries will be alternately connected for tension with a working-circuit.

In using a double switch of this description the plates *h'* and *h²* of the clock-cylinder H should be of equal length, preferably so that the respective series of batteries will be connected with the charging and working circuits for equal periods of time.

In the modified form of switch shown in Fig. 6 the letter E² indicates a bar of non-conducting material arranged to slide in guides *u*. From one end of said bar extends a pin, *e²*, through perforations in guide-plates V V', arranged at a suitable distance apart. Upon the plate V rests one end of a spiral spring, *g*, the other end of which bears against a pin, *w*, arranged through the pin *e²*. To the end of the bar E², opposite the pin *e²*, is attached an armature, E³, directly under which are arranged the poles of an electro-magnet, M², the coils of which are connected in the circuit of

the battery G^2 . The wire g^6 , leading from the magnet M , terminates in a metallic spring-finger, f^3 , which bears upon a cylinder, H^2 , as shown in Fig. 7, said cylinder being arranged in the train of a clock, I' , as is the cylinder H , heretofore described. The wire g^7 , leading from the battery, terminates in a spring-finger, f^4 , also bearing upon said cylinder and a metallic band, h^4 , which encircles said cylinder. From this band plates h^5 project laterally along the surface of the cylinder and come in contact with the finger f^3 successively as the cylinder is turned, said plates being separated by the intervening non-conducting surface of the cylinder.

The cylinder may be arranged to make a revolution in any given space of time, the battery-circuit being closed when the plates h^5 come under the finger f^3 , and at such times the magnet M^2 will be charged and attract the armature E^3 , drawing downward the bar E^2 against the tension of the spring q . When the plate passes from under the finger f^3 , and said finger rests upon the non-conducting surface of the cylinder, the battery-circuit will be broken, the magnet will release the armature E^3 , and the bar E^2 will be retracted by the spring q .

Through the bar E^2 are arranged cross-springs T , T' , and T^2 , of metal. When the armature is attracted by the magnet, the ends of these cross-springs will come in contact with metallic studs s s^1 s^2 s^3 s^4 s^5 , as shown in the drawings, and when the armature is released and the bar retracted the ends of said cross-springs will come in contact with metallic studs t t' t^2 t^3 t^4 t^5 on the opposite sides of said springs from the first-named metallic studs.

Letters S' S^2 S^3 indicate a series of secondary electric batteries, each of which is connected from one end with a charging-circuit, L , by means of wires y' y^2 y^3 , the opposite ends of said batteries being connected with studs s s^2 s^4 by the wires y^4 y^5 y^6 . The studs s' , s^3 , and s^5 are connected with the charging-circuit terminal L' by wires y^7 y^8 y^9 . The line-terminals are connected from points outwardly beyond the junctions of these branch wires by a wire, x , in which is interposed a resistance, X , for a purpose which will presently appear. Now, when the magnet attracts its armature E^3 , and the cross-springs T , T' , and T^2 are in contact with the lower metallic studs, an electric current over the charging-circuit will flow in the direction indicated by the arrows No. 1, the resistance X being so regulated that the greater portion of the current will pass over the wires y' y^2 y^3 through the secondary batteries, over wires y^4 y^5 y^6 , the connected metallic studs and cross-springs, and wires y^7 y^8 y^9 , joining again upon the line. The passage of the currents through the secondary batteries charges the same, the charging continuing for a length of time dependent upon the length of the plates h^5 of the cylinder H^2 and the speed of said

cylinder, which may be regulated so that the charging will continue for any desired period. When one of the plates h^5 passes from under the finger f^3 and the battery-circuit is broken, the bar E^2 will be retracted, so that the cross-springs T T' T^2 will come in contact with the upper metallic studs, and the connection of the secondary batteries with the charging-circuit will be broken, and said batteries will be connected in series with a working or discharging circuit, (indicated by the wire Z Z' in dotted lines.) The course of the current of the batteries in discharging is indicated by the arrows No. 4—that is, over a wire, z' , (shown in dotted lines,) to stud t , thence over the cross-spring T to stud t' , and thence over wire z^2 to battery S^2 , through said battery and from the same over wire z^3 to stud t^2 , and thence by a similar route to battery S^3 , from which it passes by a wire, z^5 , stud t^4 , spring T^2 , and stud t^5 to that portion of the working-circuit indicated by Z , passing over the same, and through any electrical apparatus interposed in the working-circuit, and over the part of the working-circuit indicated by Z' to the opposite pole of the battery S' from whence it started.

It will be seen that the secondary batteries are thus connected in tension series with the working-circuit, and will so remain until one of the plates h^5 of the clock-cylinder H^2 again comes in contact with the finger f^3 .

I prefer that the plates h^5 and intervening non-conducting spaces of the clock-cylinder H^2 shall be so proportioned that the battery-circuit will be closed about three times as long as it is broken, so that the secondary batteries will be connected with the charging-circuit, and undergo the process of charging about three times as long as they are connected with the discharging or working circuit.

In the present instance I have indicated by the letters W W a series of electric lamps connected in multiple are in the working-circuit; but any other electrical apparatus suitable for operation by dynamic electricity might be included in said circuit.

By means of the wire x and the resistance X , I provide against the charging-circuit being broken when the batteries are changed to the working-circuit, so that the same charging-circuit may be used for charging batteries at different places, or used for other purposes.

In Fig. 8 I have shown a main line, on which is located a number of stations, each containing a series of batteries and a switching device, such as shown in Fig. 1.

The switches may be operated by the time mechanism controlling the local circuit, as in Fig. 1; or, as described herein, a derived circuit from the main circuit might include the electro-magnets.

I do not limit myself to the use of a local battery for supplying the electrical current on the circuit which is closed and broken by the clock for the purpose of charging and discharging the electro-magnet which controls

the movable part of the automatic switch, as a suitable current from any other source would answer the same purpose. For instance, a circuit might be derived from either the main charging-circuit or the discharging-circuit of the secondary batteries, and include the said electro-magnet, said derived circuit being connected with the spring-fingers resting upon the circuit closing and breaking cylinder of the clock, the same as the local-battery circuit now is.

Having now fully described my invention and explained the operation thereof, I claim—

1. The combination, with a charging-circuit of secondary batteries and a switch for connecting said circuit to said secondary batteries, of a branch of said charging-circuit leading around said switch and a working-circuit having connection to said batteries through independent switch mechanism.

2. The combination, with a charging-circuit and a secondary battery, of a switch for alternately connecting said circuit to and disconnecting it from said battery, a branch circuit comprising a resistance through which the charging-circuit is connected when said battery is disconnected therefrom, and a working-circuit having connection to said battery through independent switch mechanism.

3. The combination of a charging-circuit, a series of stations, each provided with a secondary battery, and a switch for alternately connecting said battery to and disconnecting it from said circuit, a branch circuit through which the charging-circuit is connected when said battery is disconnected therefrom, and a working-circuit at each station, having connection to said battery through independent switch mechanism.

4. The combination, with a charging-circuit, a working-circuit, and a secondary battery or batteries, of an automatic switch and time-indicating devices adapted to connect said battery or batteries at predetermined intervals with the charging-circuit to be charged and the working-circuit to be discharged, and to indicate time, with independent switch devices for opening and closing the working-circuit at will, substantially as described.

5. The combination of a charging-circuit charged by a suitable electrical generator with one or more secondary batteries, a switch, and an electro-magnet for controlling it for connecting or disconnecting the said secondary battery to or from the charging-circuit, and a working-circuit having connection to said battery through independent switch mechanism.

6. The combination of a charging-circuit charged from a suitable generator, secondary or storage batteries located at intervals along said charging-circuit, and devices for introducing the batteries into the charging-circuit at the several stations, a branch at each through which the charging-circuit is connected when the battery is disconnected therefrom, whereby the batteries may be charged in series, and independent circuits from the batteries at each station.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES E. BUELL.

Witnesses:
W. B. HALE,
PHIL. W. HALE.