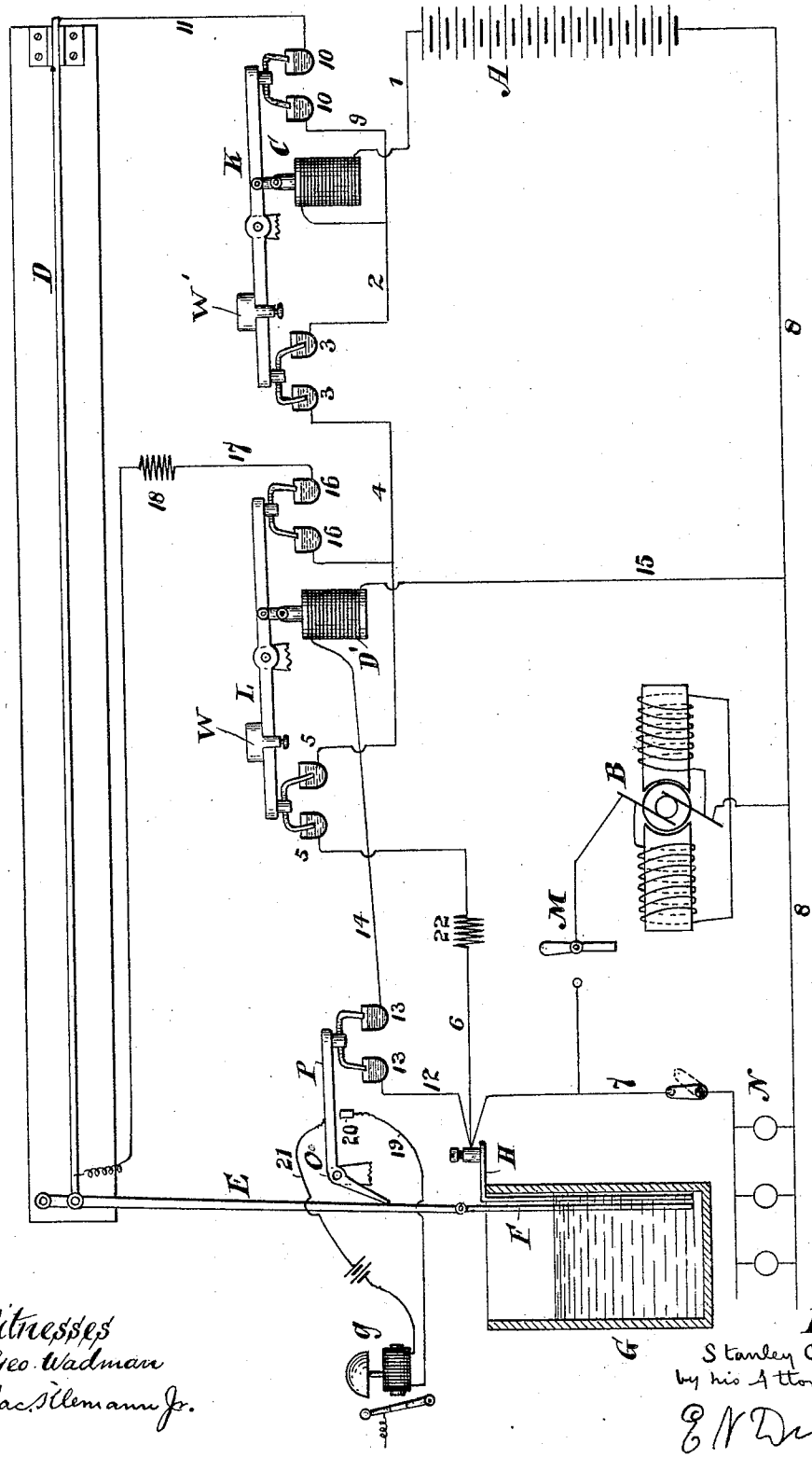
(No Model.)

S. C. C. CURRIE.

AUTOMATIC CURRENT REGULATOR.

No. 554,414. Patented Feb. 11, 1896.



Witnesses
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UNITED STATES PATENT OFFICE.

STANLEY C. C. CURRIE, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF AND EDWARD N. DICKERSON, OF SAME PLACE.

AUTOMATIC CURRENT-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 554,414, dated February 11, 1896.

Application filed May 23, 1895. Serial No. 550,328. (No model.)

To all whom it may concern:

Be it known that I, STANLEY C. C. CURRIE, of the city, county, and State of New York, have invented a new and useful Improvement in Automatic Current-Regulators, of which the following is a full, true, and exact description, reference being had to the accompanying drawing.

This invention relates to a process and apparatus for the automatic protection of secondary batteries during their charge and discharge so as to prevent their injury by a too rapid condition of change.

This invention is an improvement upon the invention for which I have made application of the 20th day of February, 1895, Serial No. 539,068, and relates to a modification of said invention, by means of which I am enabled to prevent vibration or jumping of the control-magnets under certain conditions when the currents are approaching equilibrium.

My invention will be readily understood from the accompanying drawing, which is a diagrammatic representation of my invention.

In the drawing, A represents the secondary battery and B the dynamo for charging the same.

C represents a control-magnet and D′ a cut-out magnet effecting a circuit from the control-magnet C.

D represents a rod expansible by heat operating lever E, having suspended to it plate F in the solution in tank G. Under certain conditions the current flows from the movable plate F to the fixed plate H through the solution.

g represents an alarm-bell, operative under certain conditions.

The magnets C and D′ are solenoids operating levers K L, each making double mercurial connections, as plainly shown, these connections being so adjusted that one is made before the other is broken.

M is a switch for cutting out the dynamo.

During conditions of discharge of the battery A the operation is as follows: The current passes through wire 1, solenoid C, wire 2, cups 3 3, wire 4, cups 5 5, wire 6, wire 7, translating devices or lamps N, wire 8, to battery. In case, however, the current flowing from the battery exceeds the permissible amount, the solenoid C operates the lever K, thereby making contact by wire 9, through cups 10 10 and wire 11, to expanding-rod D, thence by lever E to plate F, to plate H, to wire 7, and so to the battery. The action of the excess of current on the rod D is to expand the same, as indicated in my previously-referred-to application, thereby increasing the resistance between plate F and plate H by moving the lever E to the left. As the lever E moves to the left, it leaves the bell-crank lever P, pivoted at O, and thereby allows the circuit to be completed through a shunt-circuit, comprising wire 12, cups 13 13, wire 14, to magnet D′, which is of high resistance, and thence by wire 15 to wire 8, to battery. The effect of this is to energize the magnet or solenoid D′, operating the lever L and making contact with the cups 16 16, and thence by wire 17, through resistance 18, to the lever E. The resistance 18 is to be made practically equal to the resistance of the bar D, so that when the current is shifted from the circuit embracing the bar D to a circuit embracing the resistance 18 there will be no fluctuation in the current due to the resistance offered by the bar. As soon as the resistance between F and H is such as to reduce the current in the main circuit passing through the solenoid D′ to the permissible amount, the lever K again assumes its normal position, and the current would now flow as before through contacts 3 3 and 5 5 to the main circuit, excepting for the fact that the lever P being depressed and the contacts 13 13 closed the solenoid D′ is energized, and therefore the circuit is broken between the cups 5 5 and completed through cups 16 16, which throws in a resistance equal to that of the rod D, and the current therefore now passes by wire 17, resistance 18, lever E, and through the resistance of the liquid in tank G, and so to the main circuit.

By means of this device the current from the battery to the main circuit is compelled to pass through the liquid resistance in G, so long as the plates F H are separated beyond a determined distance, said distance being determined by the position and arrangement of the lever P.

By this device there can be no sudden change of the resistance in the circuit, and thus no jumping of the lights, as would be the case if, when the plates F H were separated considerably, the solenoid C made contact between the cups 3 3, thereby suddenly cutting out that resistance and again tending to energize the solenoid, thereby causing a vibration of the latter.

The bell J, with suitable battery, might be operated through wire 19, contact-point 20 and wire 21 as soon as the lever E was moved to the left. This, of course, is not essential.

Instead of the solenoids, magnets might be used in some cases. In all cases, however, it is essential that the levers shall be released by a less current than is required to actuate them into their downward position. For illustration, supposing one hundred ampères to be the maximum permissible current, and that one hundred and five ampères are sufficient to draw down the lever K, immediately the contacts 3 3 are broken and the contacts 10 10 made, the resistance of the circuit through D and F and G will reduce the current to, say, one hundred ampères. If the lever K should fall back at this point, it would vibrate rapidly, making and breaking the circuit. The resistance and weights W W', respectively, must be so arranged that the plates have time to separate before the armature is again released. Such adjustment is readily made on magnets by determining the distance of the armature from the magnet at the commencement and end of the stroke. Upon the gradual return of the plate F to proximity with the plate H, provided the resistance is increased in the circuit, it operates, in the first place, to release the lever K, still forcing the current to pass through the lever E and the tank G, and finally releases the lever L, when the lever E has returned to its normal position, which then breaks the circuit through the solenoid D'. When, however, the minimum of the resistance in the tank G is reached and contact broken between 13 13 and made between 5 5, the current then passes by the wire 6 through resistance 22, which is made equal to the minimum of the liquid for a similar reason as that specified in relation to the resistance 18, so that there is no sudden variation in the current by this change of the circuit.

The conditions of charge are essentially the same—that is to say, in case the switch M is closed and the dynamo operated, if an excess of current were being forced through the battery A, the solenoid C would again operate and force the charging current to pass through the resistance of the liquid, which operation will be readily understood from the previous explanation.

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

1. The combination with an electric circuit, of a source of electric energy A, a control-magnet C, a variable resistance G, an expansible apparatus D operated by heat controlling the resistance G, and a second control-magnet D' breaking the direct circuit from the magnet C to line when the resistance G has been increased to a determined amount, substantially as described.

2. The combination with an electric circuit, of the battery A, control-magnet C, expansible rod D, resistance-chamber G, control-magnet D', and the circuits shown whereby the operation of the magnet D' cuts the direct circuit from the battery A to the line and forces the same to flow through the resistance G, substantially as described.

3. The combination with an electric circuit, of the battery A, control-magnet C, expansible rod D, variable resistance G, the lever P, actuated by the expansion of the rod D, and the second control-magnet D', said magnet D' breaking the direct circuit through the magnet C to the line when the rod D has expanded, substantially as described.

4. The combination with the expanding rod D, and the resistance G of the battery A and magnet C, provided with a double circuit 2 and 11, the circuit 11 connecting with the expanding rod D operating the resistance G, and the circuit 2 being provided with a resistance 22 practically equivalent to the minimum resistance of the resistance G between the magnet C and the line, substantially as described.

5. The combination of the battery A, control-magnet C, expanding rod D, resistance G, and the second control-magnet D' and the resistances 18 and 22 and the circuits shown, whereby the vibration of the apparatus is controlled, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

STANLEY C. C. CURRIE.

Witnesses:

ANTHONY GREF,

H. COUTANT.