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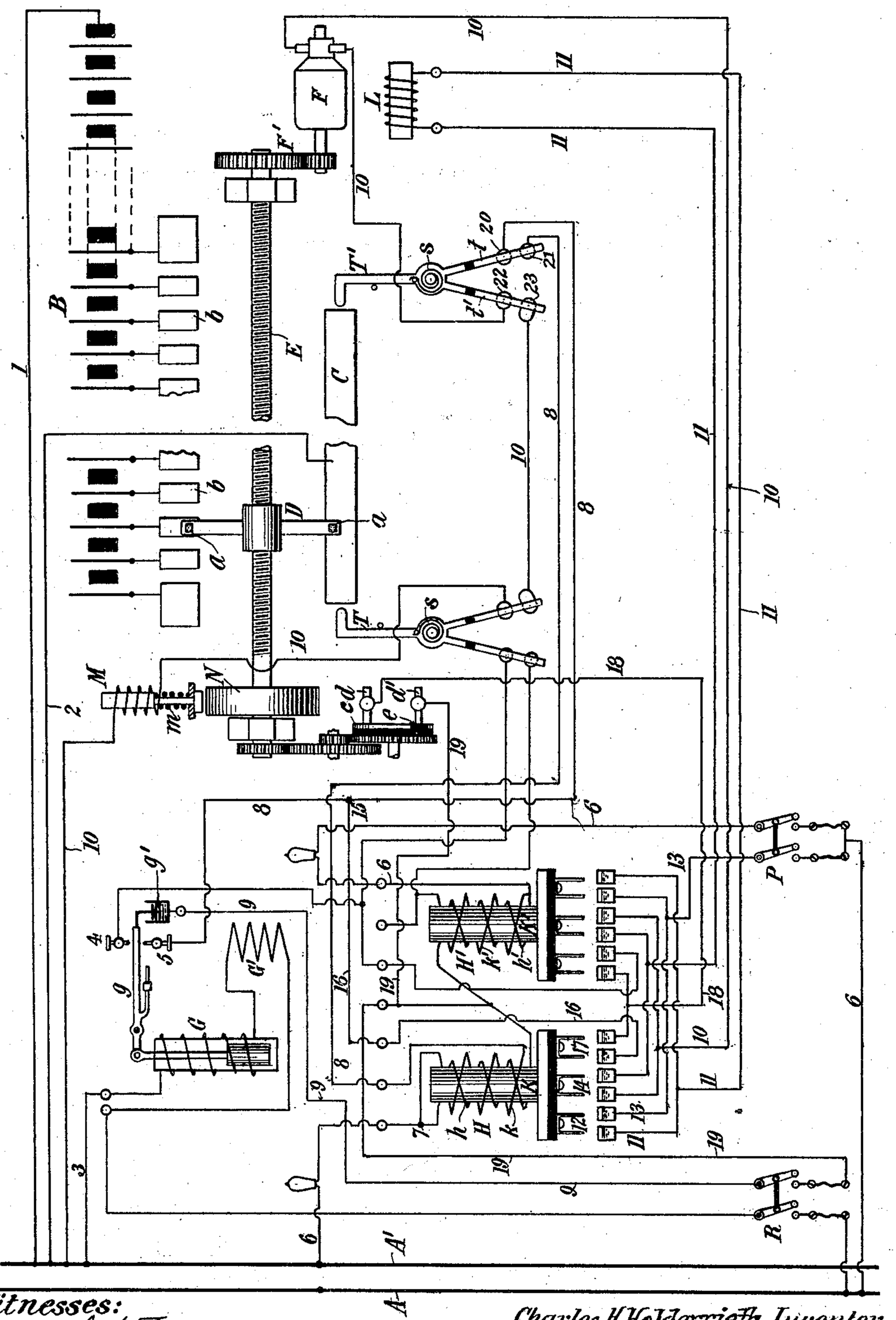
C. H. HOLDERRIETH.

AUTOMATIC REGULATOR FOR STORAGE BATTERY SYSTEMS OF DISTRIBUTION.

(Application filed June 21, 1901.)

(No Model.)



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AUTOMATIC REGULATOR FOR STORAGE-BATTERY SYSTEMS OF DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 693,863, dated February 25, 1902.

Application filed June 21, 1901. Serial No. 65,386. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. HOLDERRIETH, a citizen of the United States, residing at the borough of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Automatic Regulators for Storage-Battery Systems of Distribution, of which the following is a specification, reference being had to the drawing accompanying and forming a part of the same.

The invention subject of my present application for patent is an improvement in switches or regulators for storage-battery systems of distribution of the general class designed to maintain a constant potential between the main-line or battery terminals by throwing in or out of circuit more or less of what are termed the "end cells" to compensate for variations in the battery or line and is an automatic device for this purpose.

The primary object of the invention is to provide an apparatus which is capable of performing its intended function of automatic regulation with accuracy and certainty and in a manner which adapts it for practical use, conditions which, so far as I am aware, have not been fulfilled by any of the devices heretofore proposed for this purpose.

I shall describe the plan of construction and principle of operation of my improved apparatus by reference to the accompanying drawing, specifically pointing out by the claims the features of novelty which my invention involves.

The drawing is a diagrammatic illustration of the apparatus and such portions of the circuits as are immediately connected with the improvement.

A A′ are the main conductors or "bus-bars" of a circuit supplied with current from a series of storage-battery cells B, one of said conductors or bars, as A, being permanently connected with one battery-terminal by a wire 1 and the other through wire 2 and conducting-plate C with a movable contact D, which may be placed so as to include all of the battery-cells or any such number of the same less than the whole as may be necessary to maintain a given difference of potential between the bars A and A′. As the number of translating devices in the circuit is varied or other conditions occur to increase or reduce such difference of potential the contact D must be moved so as to cut out or include more or less of the battery-cells, as the case may be, to compensate for such variations, and the problem which I have solved by the present apparatus is to effect this operation automatically.

The contact D is composed of a plate or bar having carbon brushes *a a* at its ends, one arranged to travel in contact with the bar C, the other over the terminal plates *b b* of a certain number of end cells of the battery B. Movement is imparted to the contact D by a screw-shaft E engaging with a threaded portion of the contact and driven by an electromagnetic motor F through a train of gear-wheels F′. The direction of lateral movement of the contact D is determined by the direction of rotation of the motor, and a special device is employed which prevents it from coming to rest at any other points in its path than on one of the terminal plates *b*. This device consists of a disk *c*, geared with the shaft E, so as to make one complete revolution while the contact D is moving from the center of one terminal plate *b* to the center of the next adjacent plate. Two brushes or contacts *d d′* bear upon the disk *c*, which contains an insulating section *e* in the path of one brush, and these parts are so arranged that when once the motor has started its circuit will not be interrupted until the requisite number of cells have been switched in or out, and not then until the contact *d′* bears on the insulating portion *e* of the disk *c*, which portion of the latter corresponds to the normal positions of rest of the contact D.

The instrumentalities and circuits for controlling the operation of these devices are as follows:

G is a solenoid in a circuit 3 between the mains A A′, including a resistance G′. The core of this solenoid is connected with an adjustable pivoted lever *g*, having a downwardly-extending end that dips into a mercury-cup *g′* and oscillating between two contact-stops 4 and 5. H H′ are two other solen-

oid-magnets, the coils of which are in series in a normally closed circuit between the two mains A and A′, formed by the wire 6. Each solenoid is provided with a movable core K K′, carrying or operating a circuit-controlling device of the kind hereinafter described, and which by the magnetizing action of one of the two coils *h h′* of which each solenoid is composed are normally attracted and held in their highest position. Let it now be assumed that the potential between the mains A and A′ rises, to compensate for which a certain number of battery-cells must be switched out of circuit. The solenoid G gains power and draws up its core, lowering the lever *g* into contact with stop 5 and completing the circuit between the cup *g′* and said stop. The following then results: The current from one of the mains, as A′, flows through the wire 6 to the point 7, where it divides, one portion flowing as normally through the coil *h*, the other through a second and oppositely-wound coil *k*, surrounding coil *h*, and thence following the course indicated by the numerals 8 to the contact-stop 5. From thence the path is completed by the wires numbered 9 back to the wire 6, which latter it joins at a point between the two coils *h* and *h′*. This current neutralizes the attraction effect of the solenoid H and allows the core K to descend and complete two circuits through a series of mercury-cups or their equivalents, one a branch of the controlling-circuit, including the disk *c* and contacts *d d*, and the other including in series the field and armature of the motor and an electromagnetic brake M. This latter is or may be an ordinary solenoid and core which is held up by the current against the force of a spring *m*, but which acts upon the interruption of the current by frictional engagement with a disk N on the shaft E to check the motor of said shaft as soon as current through the motor ceases.

The course of the two circuits just referred to may be easily traced. The current from one of the mains, as A′, passes through wire 10, which, as will be seen, includes the brake M and the armature of the motor F, until it reaches one of the mercury-cups bridged by the contact 14. Thence it passes by wire 11 to and through the field-coil L of the motor and back to one of the two mercury-cups bridged by contact 12 and from the other of these cups by wire 13 to the wire 6 and through the latter to the other main A. As long, therefore, as this circuit remains closed the motor will operate to cut out battery-cells, and thus lower the potential between the mains A and A′, but in order that the contact D may not stop in a position in which it bridges two contacts *b*, as it might do by the movement of the lever *g* in case no special provisions were made to the contrary. The solenoid H is also caused to close another circuit, which is as follows: from the main A′ and wire 6 to the point 7, thence through the neutralizing-coil *k* of solenoid II, thence through wire 8 to the point 15, thence through wire 16 to one of the mercury-cups bridged by the contact 17, thence from the other cup by wire 18 to the contact *d*, through the disk *c*, and thence by contact *d′* and wire 19 back to wire 6. This circuit, it will be observed, forms a shunt around the mercury-cups *g′* and stops 5, and having been closed by the movement of the motor which brings both contacts *d d′* onto the conducting portion of the disk *c* keeps the solenoid out of action even after the interruption of the controlling-circuit by the lever *g* until the contact D is over the center of one of the terminal contacts B. Should the potential fall between mains A and A′, the lever *g* makes contact with stops 4, and if the circuits be traced it will be found that while solenoid H is not affected solenoid H′ will be neutralized and the same operations as above described will be carried out, with the exception that the current through the field and armature of the motor is reversed, causing the motor to rotate in the opposite direction.

It will be noticed that the circuit formed by wire 10 and including the motor is completed at two points through switches T and T′, and also that the controlling-circuit through wire 8, its corresponding circuit controlled by solenoid H′, are similarly completed through the same switches T and T′, respectively. The purpose of this arrangement is as follows: Each switch T T′ is a lever mounted upon a pivot and acted upon by a spring *s*, which tends to keep it in its normal position, bridging the contacts necessary for completing the reversal circuits above described. One arm of each lever T T′ extends into the path of the contact D and near the ends of such path, respectively. Should the contact D from any cause be carried too far—say to the right—in switching out cells, it encounters the lever T′, and moving the same throws one of its legs *t* off from contacts 20 21 and breaks the circuit through wire 8. Should it still continue to travel for a short distance, it throws the other leg *t′* off from the under contacts 22 23 and breaks the motor-circuit, this last-named operation being merely a precautionary measure, for if from any cause current in the controlling-circuit 8 should continue to flow after it should have ceased its interruption by the movement of the switch T′ will generally be sufficient to arrest the motor at once.

It will be seen that the operation of either switch T or T′ which breaks one of the controlling-circuits does not affect the other, so that the contact D is free to move in the opposite direction. As soon as it does so move out of engagement with the switch the latter is thrown back to its normal position by the operation of its spring.

In the drawing I have shown the complete apparatus as it would be used in a station; but I have omitted description of such parts

as do not form an essential part of the apparatus, such as the switches P R, fuses, resistance-lamps, and the like which are commonly used in such systems.

I am aware that apparatus more or less automatic in character has heretofore been devised or proposed for accomplishing the same general object—viz., the regulation of potential by varying the number of cells in circuit—which is contemplated in my invention. My improvements herein are distinguished by the use of apparatus constructed and combined in a more practicable manner.

What I claim as my invention is—

1. In a storage-battery-controlling apparatus the combination of a switch for varying the number of cells in circuit, a motor for operating the same, two circuit-controlling magnets for directing current through the motor in opposite directions and normally prevented from operation by being energized, a device responsive to variations in potential between the mains and circuits controlled thereby and adapted when completed to neutralize the two circuit-controlling magnets respectively, and for the purpose set forth.

2. In a storage-battery-controlling apparatus the combination with a switch for varying the number of cells in circuit, and a motor for operating the same, of two motor-circuit-controlling magnets, each having two opposed windings the one in a normally closed circuit the other in a circuit completed through normally open contacts, and a device responsive to variations in potential between the mains for controlling said contacts, substantially as hereinbefore set forth.

3. In a storage-battery-controlling apparatus the combination with a switch for varying the number of cells in circuit, a motor for operating the same, controlling-circuits and means responsive to variations in potential between the mains for making and breaking the same, of contact-levers through which both the motor and controlling circuits are normally completed, the said levers being placed in the path of movement of the switch and near the limits of the same and adapted to be thrown by predetermined movements of the switch and to thereby interrupt their controlling-circuits and by a further movement, the motor-circuit, as set forth.

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