S. D. SPRONG & W. E. McCOY.

VOLTAGE REGULATOR.

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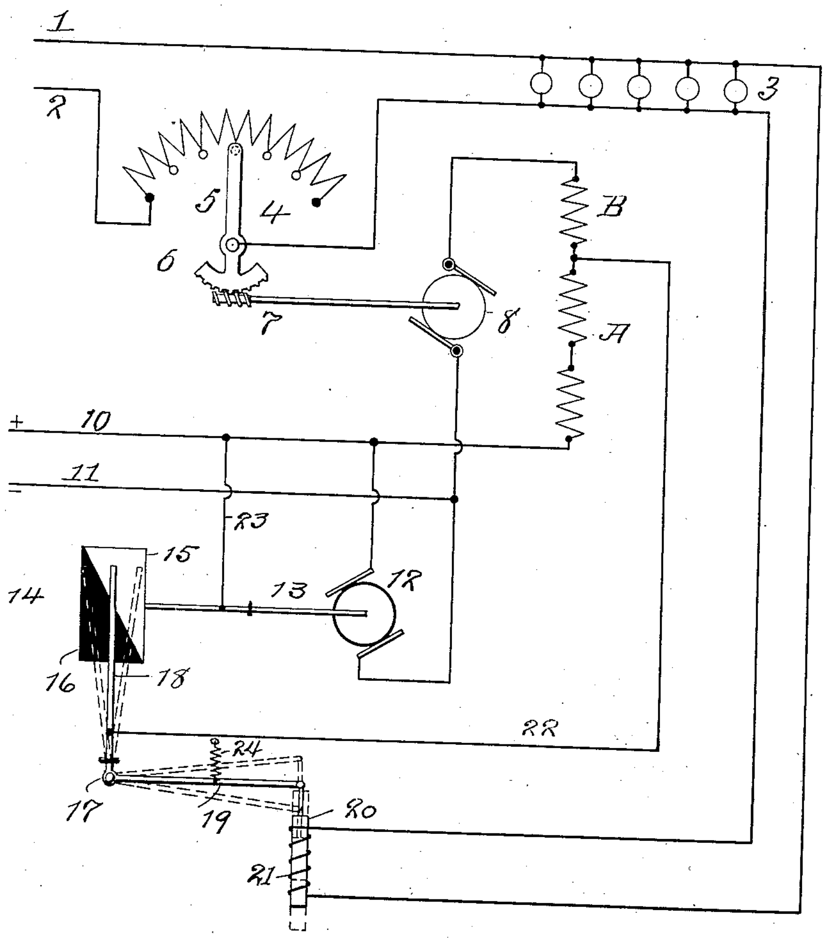

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UNITED STATES PATENT OFFICE.

SEVERN D. SPRONG AND WALTER E. McCOY, OF NEW YORK, N. Y.

VOLTAGE-REGULATOR.

No. 921,299. Specification of Letters Patent. Patented May 11, 1909.

Application filed October 3, 1908. Serial No. 455,989.

To all whom it may concern:

Be it known that we, SEVERN D. SPRONG and WALTER E. McCOY, citizens of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Voltage-Regulators, of which the following is a specification.

The invention is a device for regulating the voltage on a circuit, and is more especially devised to obviate the usual lagging of contact making controlling apparatus behind the actual voltage changes, due to the inertia of the parts and the gap between the contacts.

The invention consists in the combination in a circuit voltage regulator, of means for compensating for voltage variations, means governed by periodic reversal of its energizing field for controlling said compensating device, and means controlled by the voltage on said circuit for varying the relative duration of said reversals: also in the various combinations more particularly set forth in the claims.

The accompanying drawing is an electrical diagram.

1 and 2 are the conductors of the load circuit, between which the voltage may vary and so require regulation. The load may be glow lamps, as indicated at 3. In series with the load is a variable rheostat 4, the pivoted contact arm 5 of which carries a curved rack 6, which engages with a worm 7 on the shaft of series motor 8, so that the arm 5 is moved to cut resistances into or out of circuit by the rotation of said motor 8 in one direction or the other. The field winding of motor 8 is divided into two unequal sections, the major section A having approximately two thirds of the total ampere turns, and the minor section B having the remaining one third of said turns. The coil in section A is wound in the opposite direction to the coil in section B.

10 and 11 are conductors leading from any source of direct current supply. The conductor 10 connects with one terminal of the field winding. The other terminal of said winding connects with motor 8. A second motor 12 is connected across conductors 10 and 11. Both motors 8 and 12 connect to conductor 11.

On the shaft 13 of motor 12 is a cylinder 14 of metal, having its circumferential periphery (indicated in the drawing as developed in a plane, and hence, in the form of a parallelogram) divided diagonally into two parts, over one of which, 15, the metal is exposed while the other part, 16, is covered with insulating material.

17 is a pivoted bell crank lever, the extremity of one arm 18 of which makes contact with cylinder 14; the other arm 19 carries the core 20 of a solenoid 21, the terminals of which are connected to circuit conductors 1 and 2. The arm 18 which is insulated from the rest of the bell crank lever, is connected by wire 22 to the field winding of motor 8, at a point between the sections A and B of said winding. The cylinder 14 is insulated from the motor 12 and is connected to direct conductor 10 by wire 23.

Referring now more particularly to the cylinder 14, it will be obvious, that when the contact arm 18 is in the intermediate position, shown in full lines in the drawing, the periods during which the circuit, which includes major section A of the motor field winding, will be opened and closed, per revolution of said cylinder, will be equal. Or, in other words, the circuit will be opened half the time, and closed half the time. If the arm 18 be swung to the right, then the periods of make of circuit will increase and the periods of break correspondingly decrease, while, if said arm be swung to the left, the periods of make of circuit will decrease and the periods of break correspondingly increase.

Because the sections A and B of the field winding of motor 8 are wound in relatively opposite directions, and because the turns of major section A are twice as many as the turns of minor section B, it is obvious, that if both sections of the winding are in circuit, one half of major section A will be neutralized by minor section B, and hence, the remaining half of major section A will determine the direction of rotation of the motor 8. On the other hand, if major section A be short circuited, then only the minor section B will control the motor and consequently cause its rotation in the opposite direction. Now, the short circuiting of major section A depends upon whether the arm 18 is in contact with the insulated or the uncovered portion of the periphery of cylinder 14; while the time during which the short circuiting continues depends upon the position of said arm on said cylinder. Assume the normal condition to be as indicated by full lines in the drawing the solenoid pull being balanced by a helical spring 24 attached to arm 19. Then, because the arm 18 is held by the solenoid 21 in the middle position on cylinder 14, the short circuiting of major section A occurs during half of each revolution of said cylinder. Hence, during each revolution of cylinder 14, the direction of rotation of the motor 8 is controlled half the time by minor section B of the field winding, and half the time by major section A, and, hence, at each revolution of said cylinder, there will be an effort on the part of motor 8 to turn alternately in opposite directions. But the speed of rotation of cylinder 14 is to be made such that when these reversals occur over equal intervals of time, there will be no appreciable rotation of the motor 8 in either direction. So that, so long as the voltage on the load circuit remains constant, the motor 8 remains practically at rest, and hence, the arm 5 of rheostat 4 is not moved either to cut in or cut out resistance. Suppose now, that the voltage on the load circuit increases. The solenoid 21 then draws in its core and moves the arm 18, so that during each revolution of cylinder 14, the period during which said arm 18 is in contact with the metallic part 15 of the periphery of said cylinder is greater than the period during which it is in contact with the insulated part 16 of said periphery. Then, major section A of the field winding of motor 8 will be short circuited for a longer period, and hence, minor section B will, for that longer period, be free to control the direction of rotation of the motor 8. The result then is, that the motor 8 rotates in such direction as to move the rheostat arm 5 to the right of the drawing, and so to cut resistances into the load circuit until the voltage again becomes normal, when the solenoid 21 rings the arm 18 back to its original middle position on cylinder 14. Conversely, if the voltage on the load circuit falls off, the diminished attraction of solenoid 21 causes the arm 18 to move further upon the insulated portion 16 of cylinder 14, with the result, that the period in each revolution of cylinder 14, during which major section A is short circuited, is diminished. Hence, during the greater part of each revolution of cylinder 14, the section A of the field winding of motor 8 controls the direction of rotation of the motor, and hence, the motor turns in the opposite direction and moves the rheostat arm 5 to cut out resistances until the normal voltage is restored; when, as before, the apparatus reverts to its original condition. It will be apparent, therefore, that as the relative time of make and break at cylinder 14 varies, so will the effective travel of motor 8 because of the predominance of one or the other section of the motor field: that this effective change of motor travel alters the position of the rheostat arm to cut in or out resistance and so compensate for the voltage change in the load circuit: and that, when through the equalization of the time of make and break, the normal voltage is restored, the motor 8 is brought to rest.

We claim:

1. In a circuit voltage regulator, means for compensating for voltage variations, means governed by periodic reversals of its energizing field for controlling said compensating means, means for generating said field, and means controlled by the voltage on said circuit for varying the relative duration of said reversals.

2. In a circuit voltage regulator, a motor, means for compensating for voltage variations in said circuit controlled by said motor, means for alternately reversing the effective field of said motor, and means controlled by the voltage on said circuit for varying the relative duration of said reversals.

3. In a circuit voltage regulator, means for compensating for voltage variations in said circuit, a motor controlling said compensating means and having its field winding divided into two unequal and oppositely wound sections, and means controlled by the voltage on said circuit for short circuiting the major section of said winding for a greater or less fraction of a predetermined period of time.

4. In a circuit voltage regulator, a variable resistance, a motor controlling said resistance and having its field divided into two unequal and oppositely wound sections, a rotary commutator for making and breaking the current in the major section, and means controlled by the voltage on said circuit for varying the relative duration of said makes and breaks.

5. In a circuit voltage regulator, a variable resistance, a motor controlling said resistance and having its field divided into two unequal and oppositely wound sections, a rotary commutator cylinder having on its periphery alternating V-shaped insulating and metallic surfaces, a contact arm on said cylinder, and a solenoid disposed in said circuit and controlled by the voltage thereon.

In testimony whereof we have affixed our signatures in presence of two witnesses.

SEVERN D. SPRONG.
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Witnesses:
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