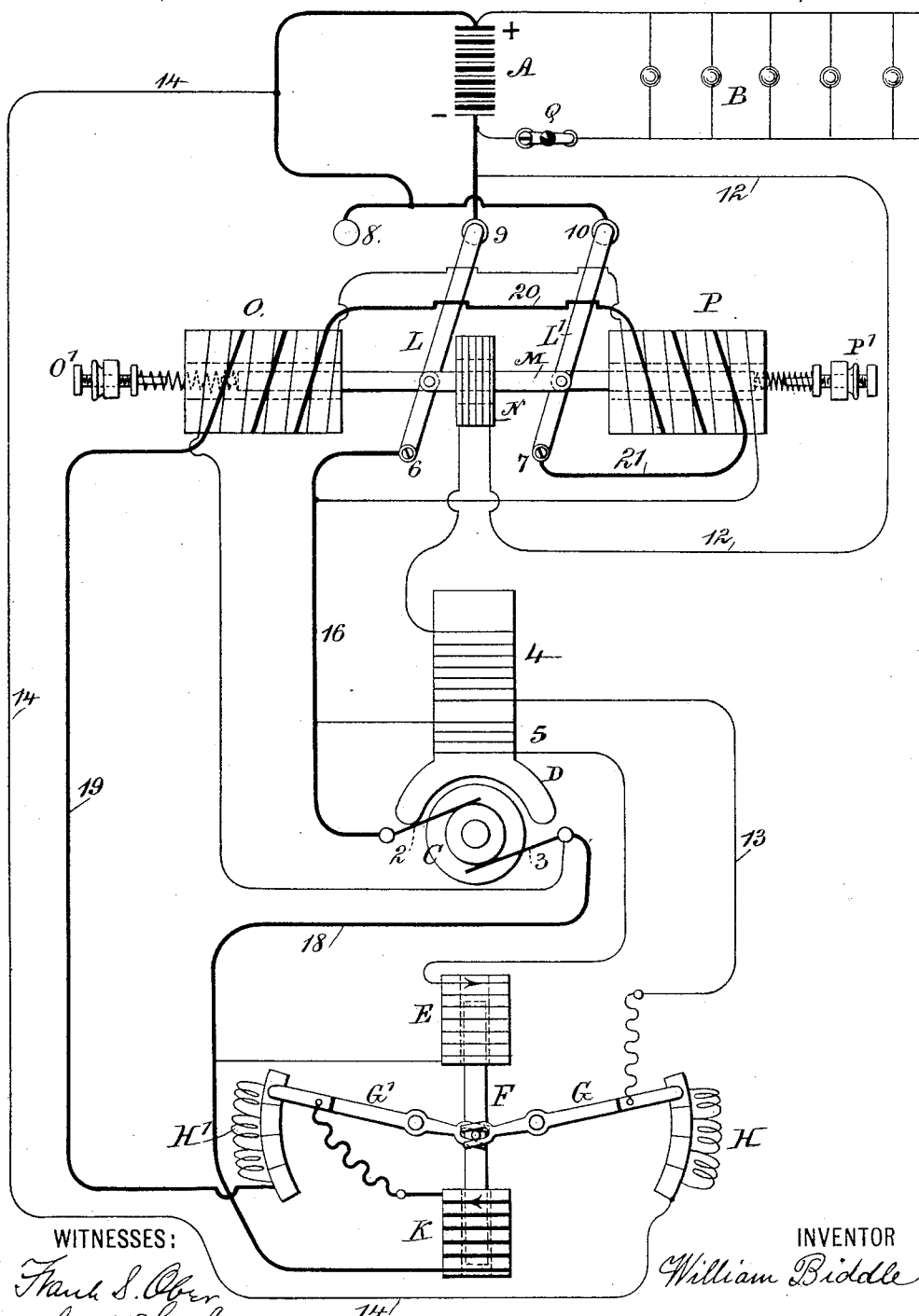


(No Model.)

W. BIDDLE.
CIRCUIT REGULATING DEVICE IN ELECTRIC CAR LIGHTING APPARATUS.
No. 531,765.

Patented Jan. 1, 1895.



WITNESSES:

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WILLIAM BIDDLE, OF BROOKLYN, NEW YORK.

CIRCUIT-REGULATING DEVICE IN ELECTRIC CAR-LIGHTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 531,765, dated January 1, 1895.

Application filed May 28, 1894. Serial No. 512,612. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BIDDLE, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented an Improvement in Circuit-Regulating Devices in Electric Car-Lighting Apparatus, of which the following is a specification.

In Letters Patent No. 519,998, granted April 10, 1894, to Biddle and Kennedy, there is a storage battery for energizing incandescent lamps in multiple arc and a dynamo rotated by a connection to the car axle and a three-point switch for regulating the direction of current in passing to the storage battery and lamps, whether the car is going in one direction or in another direction.

The object of the present invention is to render nearly uniform the currents passing from the armature through the main and shunt circuits to the storage battery, so that the current of the armature will be properly proportioned to the electromotive force of the field magnets to lessen or prevent sparking at the commutator brushes, and by my present arrangement the regulation is effected automatically so as to require little or no personal attention.

In the drawing, I have represented the present improvements by a diagram.

At B there are illustrated incandescent lamps in multiple arc.

C represents the armature with the commutator brushes 2 and 3, and D the field magnet in which the main helix 4 is in a shunt of the storage or secondary battery A, the circuit to which is not broken, but more or less resistance is thrown into the circuit, as hereinafter designated, and 5 is a neutralizing helix oppositely wound to the helix 4, which helix 5 is in a shunt between the commutator brushes 2 and 3, and in this same shunt is a helix E that acts upon the solenoid or core F of the rheostat composed of the circuit changing levers G G' and the resistances H H', and the circuit containing the helix 4 passes by a flexible connection to the lever G and through more or less of the resistance H according to the position of such lever G in the rheostat.

The helix K acts in the opposite direction upon the core F to the helix E, and this helix K is in the main circuit passing from the com-

mutator brush 3, there being a flexible connection between the helix K and the rheostat lever G', and the resistance H' is in the main circuit and more or less of such resistance is thrown into the main circuit according to the position of the lever G' as moved by the core or solenoid F under the joint action of the magnetism set up by the helices E and K.

The three-point switch bars L and L' are pivoted at 6 and 7 and contact with the circuit closers 8, 9 and 10. The object of this three-point switch is only to give direction to the current in passing from the dynamo to the storage battery so that the current will always reach the battery in the same direction regardless of the direction of rotation of the axle and wheels of the car.

The switch bars L and L' are connected by the solenoid or core M which is polarized by a helix N around the core M, and this helix N is in the shunt circuit containing the helix 4 of the field magnet, and the ends of the solenoid core M are within the helices O and P which are compound wound and each contains two wires, the fine wire being in a shunt between the brushes 2 and 3 and the coarse wire helices being in the main circuit from the brushes 2 and 3, which main circuit passes through the switch bars L L' to the storage battery. It will now be observed that the helix N which polarizes the solenoid core M is in the shunt between the poles of the secondary battery, and hence such helix N always acts to magnetize the core M in the same direction, and the extent of the current flowing by the wire 12 through the helix N and helix 4 and by the wire 13 and lever G, resistance H and wire 14 to the other pole of the storage battery, will depend upon the resistance of the helices and of the rheostat H according to the position of the lever G, and the helices O and P are to be wound in such a manner that the current flowing through the same in one direction will tend to move the solenoid core M and bring the levers L and L' into contact with 9 and 10, but if the current flowing through the helices O and P is reversed in consequence of the armature C being revolved in the other direction, the magnetism set up by the helices O and P will shift the three-point switch L L' from 10 and close contact between 8 and L and 9 and L', thereby causing the current to

reach the storage battery in the proper direction.

The commutator brush 2 is connected with the switch bar L by the wire 16 in the main circuit, and the commutator brush 3 is connected by the wire 18 in the main circuit with the helix K, and the wire 19 extends from the rheostat H' to the helix O and thence by the wire 20 to the helix P, and by the wire 21 to the switch bar L'; and it will be seen that the current passing from 3 by 18, goes through the helix K and by the flexible connection and lever G' through the rheostat H', and according to the position of the lever G', so more or less of resistance will be thrown into this main circuit.

If the rotation of the armature C is diminished by the speed of the train diminishing, the electromotive force of the armature will necessarily fall and the action of the neutralizing coil 5 will lessen, and the magnetic energy will be increased in proportion by the current flowing through the coil 4, and the helix E will not act as powerfully upon the core F, and the movement of the lever G will throw in more resistance from the rheostat H in the shunt circuit of the secondary battery. At the same time the main circuit passing from 3 through 18, K and G' and including the secondary battery, will not be materially changed because of the increased magnetic energy in the field magnet K, and hence the liability to spark at the commutators would be increased. The magnet K however counteracts this tendency by its superior force moving the solenoid core F and lever G', throwing in more resistance by the rheostat coils H' into the main circuit. Hence by this arrangement as the armature shunt containing the helices 5 and E weakens, more resistance is thrown into the shunt of the storage battery containing the coil 4 and also into the main circuit of the armature passing through the brushes and helix K by the rheostat coils H', thus equalizing the action and preventing sparking at the armature brushes by the additional resistance thrown into the main circuit, and as the electromotive force of the armature increases by the increased rotation, and the shunt helices 5 and E are more highly energized, resistance is thrown out proportionately by the movement of the circuit levers G and G' until the resistances H and H' are entirely thrown out of the respective circuits, but in this operation the helix 5 will cut down the efficiency of the field magnet D proportionately, so as to maintain nearly the same voltage in the main circuit regardless of the speed of rotation of the armature.

The entire apparatus is automatic, or nearly so, but I usually provide a switch at Q that can be operated by hand to turn on or off the current to the incandescent lamps B or other working devices.

It is to be borne in mind that the sparking

at the commutator brushes is largely due to the neutral line of the armature not corresponding to the neutral line of the field magnet because the increased speed and consequent electromotive force cause the neutral line or angle of lead of the armature to move in the direction of rotation. By cutting down the ampères of the armature by adding resistance as aforesaid the neutral line of the armature is caused to remain nearly stationary.

The core F may be divided longitudinally into two bars, one carrying the pin for the lever G' and the other the pin for the lever G so that they may respond according to the variations in the electric energy in throwing more or less resistance into the circuits.

I prefer and use screws O' P' and springs at the ends of the polarized core M that moves the three-point switch, so that when the electromotive force of the dynamo sinks as low as that of the secondary battery, the springs may move the switch to an intermediate position and automatically break the circuit between the battery and dynamo.

I claim as my invention—

1. The combination with a secondary battery and a dynamo having its field energizing helix in a shunt to the secondary battery, of a neutralizing helix in a shunt to the armature brushes, a three-point switch and main circuit connections to the armature brushes and the secondary battery respectively, helices for actuating the three-point switch, such helices being double wound with one helix in the main circuit to the secondary battery and the other helix in a shunt between the armature brushes, substantially as set forth.

2. The combination with a secondary battery and a dynamo having its field energizing helix in a shunt to the secondary battery, of a neutralizing helix in a shunt to the armature brushes, a three-point switch and main circuit connections to the armature brushes and the secondary battery respectively, helices for actuating the three-point switch, such helices being double wound with one helix in the main circuit to the secondary battery and the other helix in a shunt between the armature brushes, and a helix in the shunt circuit of the secondary battery for polarizing the core of the magnets that move the three-point switch, substantially as set forth.

3. The combination with a secondary battery and a dynamo having its field energizing helix in a shunt to the secondary battery, of a neutralizing helix in a shunt to the armature brushes, a three-point switch and main circuit connections to the armature brushes and the secondary battery respectively, helices for actuating the three-point switch, such helices being double wound with one helix in the main circuit to the secondary battery and the other helix in a shunt between the armature brushes, rheostats or re-

sistances in the shunt circuit of the secondary battery and in the main circuit, circuit levers for varying the resistances of the rheostats in the respective circuits, a helix in the shunt circuit of the brushes containing the neutralizing helix of the field, a helix in the main circuit and a solenoid core for actuating the circuit levers of the rheostat, substantially as set forth.

4. The combination in an apparatus for lighting railway cars, of a secondary battery, a dynamo with an armature driven at varying speeds by a connection to the car axle, a field magnet of the dynamo having an energizing helix in a shunt circuit from the secondary battery and a neutralizing helix in a shunt to the armature brushes, a three-point switch for changing the circuit connections according to the direction of rotation of the armature, electro-magnets for giving motion to the three-point switch and changing the circuit connections automatically, resistances in the shunt circuit from the secondary battery and in the main circuit respectively, and circuit levers and electro-magnets for actuating the same and varying the resistances of the rheostats in the respective circuits according to the current set up in the armature

by the varying speeds of rotation, substantially as set forth.

5. The combination with the secondary battery and its working circuit and a dynamo driven at different speeds, of a three-point switch in the circuit between the dynamo and battery, electro-magnets for moving the same and changing the circuits automatically, and springs for automatically breaking the circuit when the electromotive force sinks as low as the battery, substantially as specified.

6. The combination in a car lighting apparatus of a dynamo having an armature that is driven at varying speeds, a secondary battery and circuit therefrom through the field helix, a main circuit through the commutator and armature, a rheostat and a helix in said main circuit and a lever actuated by the core of the helix to vary the resistance by the rheostat in proportion to the electromotive force developed by the varying speeds of the armature, substantially as specified.

Signed by me this 23d day of May, 1894.

WILLIAM BIDDLE.

Witnesses:

GEO. T. PINCKNEY,
A. M. OLIVER.