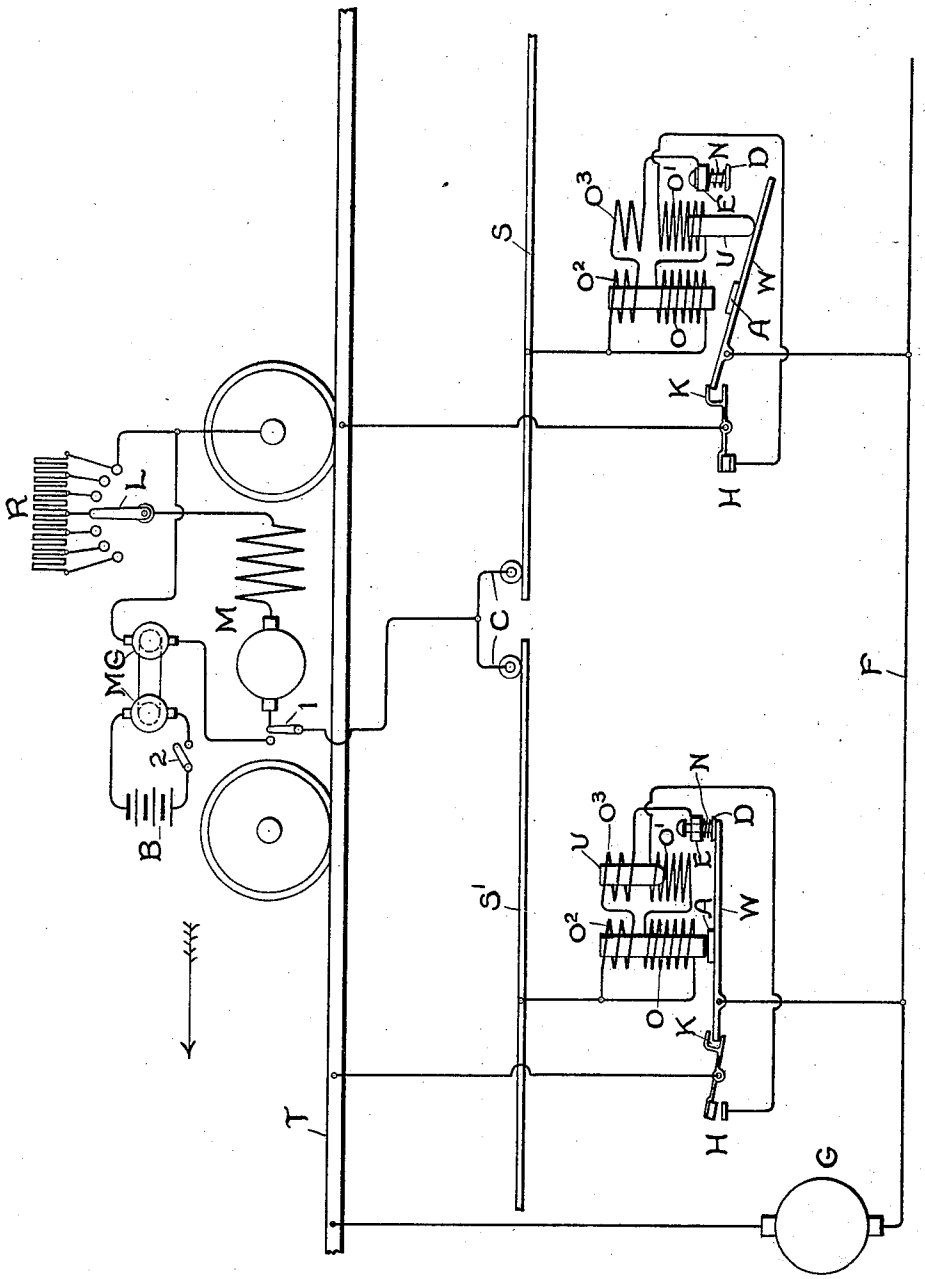
No. 687,098. Patented Nov. 19, 1901.

G. T. WOODS.

ELECTRIC RAILWAY.

(Application filed June 29, 1900.)

(No Model.)



Witnesses.
Edward Williams, Jr.
Alex. F. Macdonald.

Inventor:
Granville T. Woods,
by Albert G. Davis
Atty.

UNITED STATES PATENT OFFICE.

GRANVILLE T. WOODS, OF NEW YORK, N. Y., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 687,098, dated November 19, 1901.

Application filed June 29, 1900. Serial No. 22,022. (No model.)

To all whom it may concern:

Be it known that I, GRANVILLE T. WOODS, a citizen of the United States, residing at New York, county of New York, State of New York, have invented certain new and useful Improvements in Electric Railways, (Case No. 1,034,) of which the following is a specification.

This invention relates to improvements in electric railways.

The drawing is a diagrammatic illustration of a railway embodying the invention.

The generator which supplies current to the system is represented by G, and the supply-circuit by the feeder F and track rail or return T. The service or working conductor is divided into sections S S′ and is engaged by a collector C, carried by the car, which bridges adjacent sections. M represents any desired number of motors carried by the car, and L a suitable controller for the motors, connected between the motors and the car-wheels and track-return. Each section of the service-conductor is adapted to be connected with the feeder F by a pivoted electromagnetic switch W whenever the collector C engages with that section, the switch being closed by current passing through the collector from the preceding section to the energizing-coil of the switch, and thence to the track-return.

The switches W are normally open, and a pivoted switch H in the circuit of the energizing-coil O, which is connected to ground, is normally closed. When the switch W is raised, it engages with a contact D, which is movably mounted in the terminal E of the connection between the feeder F and conductor-section S and which is normally forced downward by a spring N. After the switch W has engaged the contact D its other end engages with the lower portion of the fork K of the pivoted switch H to move the latter and open the ground connection. The switch W is then held in its closed position by the coil O^2, which is in series with the connection between the feeder F and the conductor-section S, now closed by the switch W. In the apparatus so far described the switch W would be liable to be held closed after the collector C had been carried to the succeeding conductor-section, so that the first conductor-section would remain alive. The sticking of the switch might be caused by mechanical friction, by residual magnetism in the switch-magnet, or by leakage currents, and a very small current will suffice to keep the switch closed even if the parts are in good working order, as it requires much less current to keep the switch closed than to close it in the first place. In order to guard against such an occurrence, the following means is provided: A gravity-plunger U is adapted to be raised by a coil O′, in series with the energizing-coil O, when current passes through the coils to raise the armature A, attached to the pivoted switch W. This plunger has a relatively large mass. It requires considerable current to maintain it in its elevated position, and when it falls it impinges with such force against the switch W that the latter is opened against the action of the forces tending to maintain it closed. Thus when the collector C is carried to the next conductor-section unless a short circuit is established the plunger U will descend and insure the opening of the switch W even if there is considerable friction in its bearing and residual magnetism in its magnet. The time of the fall of the plunger is dependent upon the number of turns of its coils O^3, and hence the strength of current which will be insufficient to hold the plunger in its raised position may be determined in advance. This means for insuring the opening of the switch may be embodied in the various types of surface-contact electric railways.

It is not practicable to use a battery on the car for the purpose of energizing the electromagnetic switches to start the car on a dead-section on account of the great size and weight of a battery which will furnish current of the desired potential. This difficulty is overcome by providing means whereby a current of sufficient potential is derived from a small battery. The motor-generator MG is carried by the car, and its generator end is constructed to develop a higher electromotive force than that of the battery B. This battery B may be connected by the switch 2 with the motor end of the motor-generator, and the generaror end may be connected with the

collector C by the switch 1, which connects the car-motor M with the collector. The current supplied to the switch-coil O will then be sufficient to close the switch W even if a battery of very low potential be used, and as current is required from the battery for only a short time even if the switch is held closed by a coil in shunt with the car-motor M instead of by a series coil a small battery will fulfil all demands made upon it. After the switch W has thus been closed the switch 1, which bridges the generator-terminal and the terminal of the propelling-motor M, may be moved to engage the motor-terminal alone, or it may be held in its bridging position in order to recharge the battery. When the switch 1 is moved to be connected only with the terminal of motor M, the switch 2 is opened. The switches 1 and 2 may be made a part of the controller L, if desired.

It is obvious that the bridging position of switch 1 is maintained only while the car is in motion, so that the battery B may thereby be charged. When the circuit between generator G and motor M is broken, switch 1 must be moved to connect the terminal of the motor-generator only or controller L must be opened or a very heavy resistance cut into circuit by said controller, so that the generator side of the motor-generator MG will not be short-circuited. If switches 1 and 2 are made a part of controller L, then the operation of the controller will automatically cut motor M out of the circuit and cut the motor-generator into the circuit. Thus the motor-generator at times has its motor part at one end while its generator part is at the other end, and at other times the said parts are reversed in their action.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, and mechanical means for automatically forcing said switch to open when no current in excess of a predetermined minimum is flowing through its coil.

2. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, an electromagnetic device having its coil in series with the coil of said switch, a mechanism controlled by said device for forcing said switch open when no current in excess of a predetermined minimum is flowing through the switch-coil.

3. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, a device which is adapted to open said switch mechanically, and a coil in series with the coil of the switch, which series coil maintains said device inoperative while current in excess of a predetermined minimum is flowing through the switch-coil.

4. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each such section and the feeder, an electromagnetic switch for each such connection, and a gravity-plunger which is sustained in an elevated position while a current greater than a predetermined minimum is flowing through the coil of said switch, and when no such current is flowing descends to force the switch open.

5. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, a gravity-plunger adapted to engage said switch in its fall, and a coil in series with the coil of said switch, which controls said plunger.

6. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a switch for each such connection, a traveling collector adapted to engage with said conductor, a coil in a grounded shunt from said collector for closing said switch, and an electrically-controlled plunger for forcing said switch open.

7. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a normally open feeder-switch for each such connection, a connection between each conductor-section and the ground, a coil in said ground connection for closing said feeder-switch, a switch for said ground connection which is opened when the feeder-switch closes, a coil in the feeder connection for holding the feeder-switch closed, and means for forcing said feeder-switch to open when no current in excess of a predetermined minimum is flowing through said feeder connection.

8. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor and the feeder, a normally open feeder-switch for each such connection, a connection between each conductor-section and ground, a coil in said ground connection for closing said feeder-switch, a movable terminal in said feeder connection which is engaged by said feeder-switch, a switch for said ground connection which is opened by the feeder-switch in its movement after having engaged said movable terminal, and a coil in the feeder connection for holding the feeder-switch closed.

9. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a normally open pivoted feeder-switch in each such connection, a connection between each conductor-section and ground, a coil in said ground connection for closing the feeder-switch, a normally closed

pivoted switch for said ground connection which is provided with a fork adapted to be engaged by the feeder-switch to open the ground-switch when the feeder-switch closes, and to close the ground-switch when the feeder-switch opens, and a coil in the feeder connection for holding the feeder-switch closed.

10. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, an electromagnetic switch for each such connection, and an electrically-controlled gravity-plunger for forcing said switch to open.

11. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a switch for each such connection, a connection between each conductor-section and ground, a coil in each such connection for closing said switch, and an electrically-controlled plunger for opening said switch.

12. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a normally open switch for each such connection, a collector carried by the motor-car and connected with the car-motors, a grounded shunt from the collector, a coil in said shunt for closing said switch, a gravity-plunger for forcing said switch open, and a coil in said shunt in series with the first coil for lifting said plunger.

13. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a switch in each such connection, a traveling collector, a gravity-plunger for opening said switch, two coils in series with each other and in a grounded shunt to the collector, one for closing the switch and the other for lifting the plunger, and two coils in series with each other and with the collector, one for holding the switch closed, and the other for maintaining the plunger in its elevated position.

14. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a switch in each such connection, a traveling collector, a gravity-plunger for opening said switch, two coils in series with each other and in grounded shunt to the collector, one for closing the switch and the other for lifting the plunger, a return connection through the last-named coil, a switch in said connection which is opened by the feeder-switch in its closing movements, and two coils in series with each other and with the collector, one for holding the switch closed, and the other for maintaining the plunger in its raised position.

15. In an electric railway, the combination with the feeder, of a sectional conductor, a connection between each conductor-section and the feeder, a normally open electromagnetic switch in each such connection, a car, a battery on the car, a collector carried by the car and coöperating with the sectional conductor, and a motor-generator on the car adapted to be connected with the battery and collector to supply current to said electromagnetic switch at a higher potential than the battery-current.

In witness whereof I have hereunto set my hand this 26th day of June, 1900.

GRANVILLE T. WOODS.

Witnesses:
F. C. BATES,
WILLIAM S. BRAYTON.