No. 719,983. PATENTED FEB. 10, 1903.

F. M. ASHLEY.

ELECTRIC RAILWAY.

APPLICATION FILED FEB. 26, 1898.

NO MODEL. 4 SHEETS—SHEET 1.

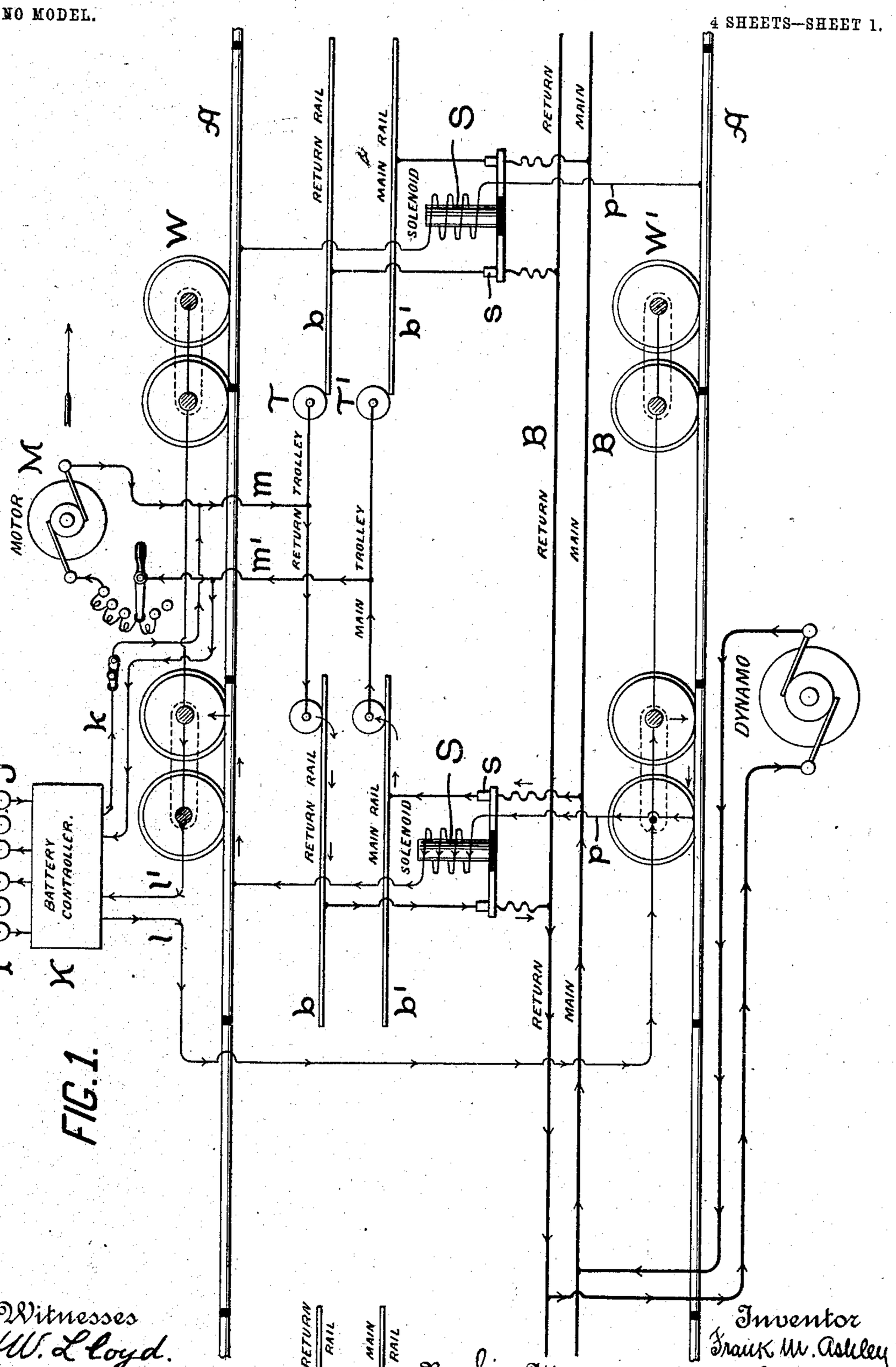

FIG. 1.

Witnesses
H. W. Lloyd.
A. Z. Macdonald.

Inventor
Frank M. Ashley
By his Attorney
Albert G. Davis

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NO MODEL. 4 SHEETS—SHEET 2.

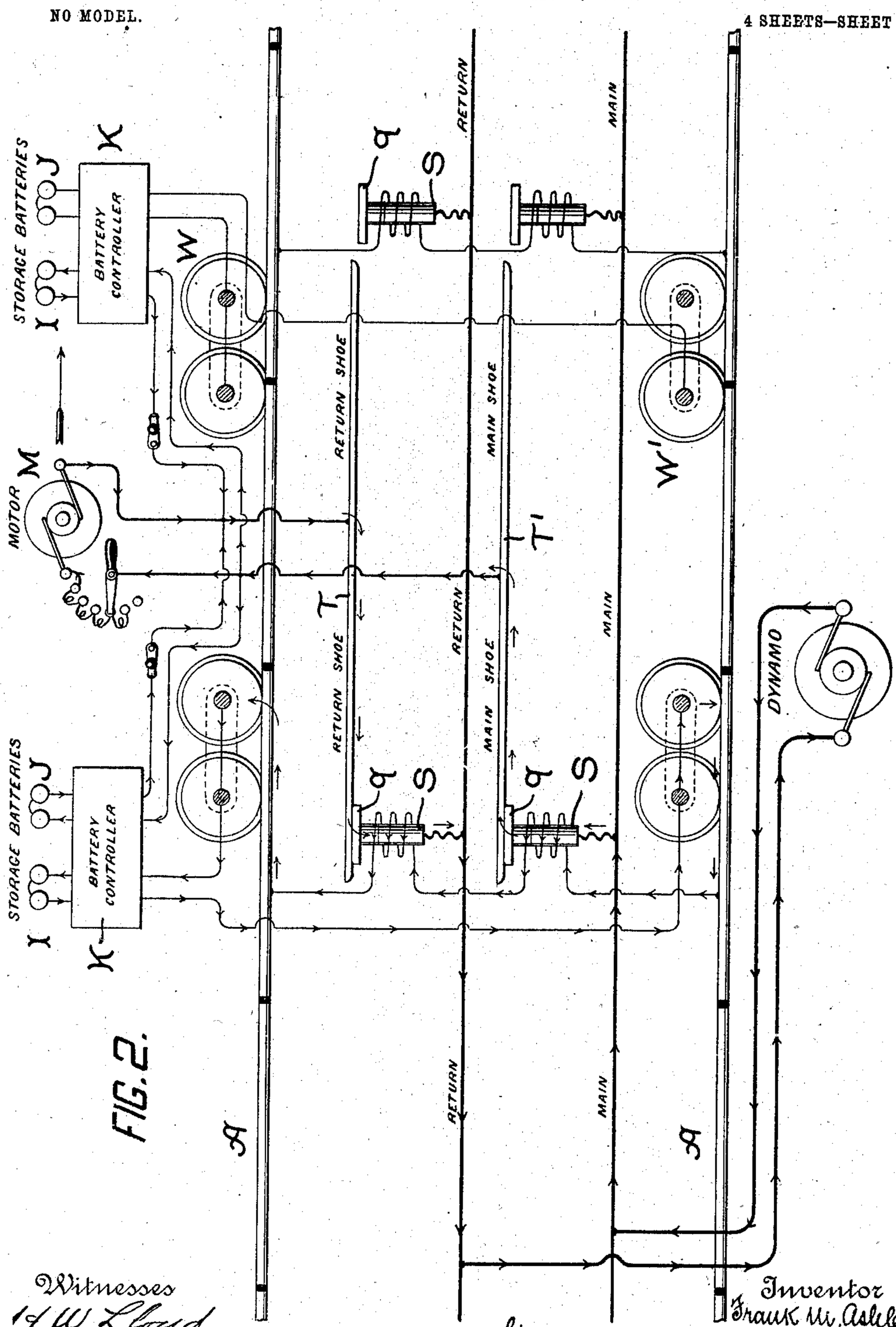

FIG. 2.

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NO MODEL. 4 SHEETS—SHEET 3.

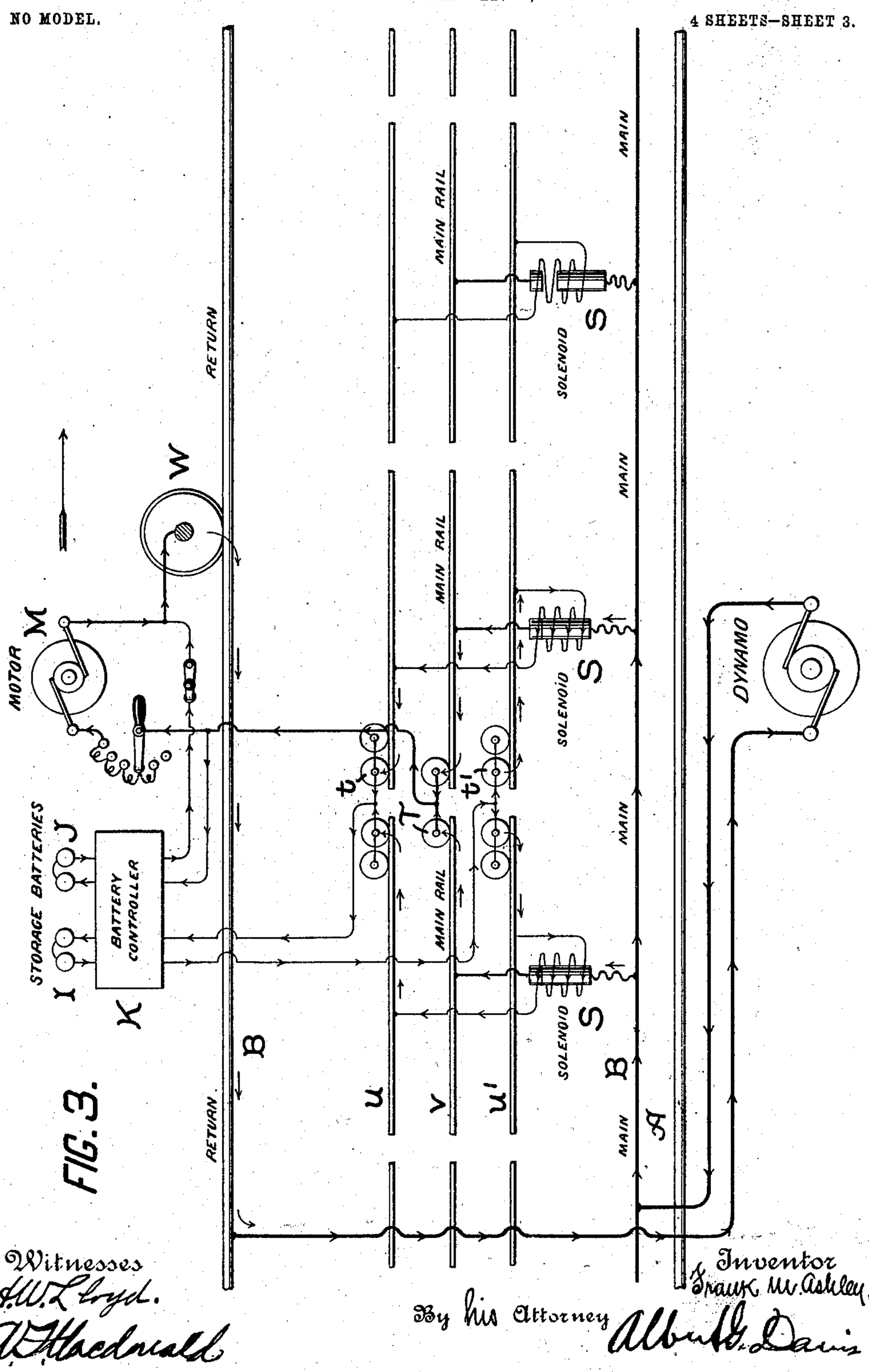

FIG. 3.

Witnesses
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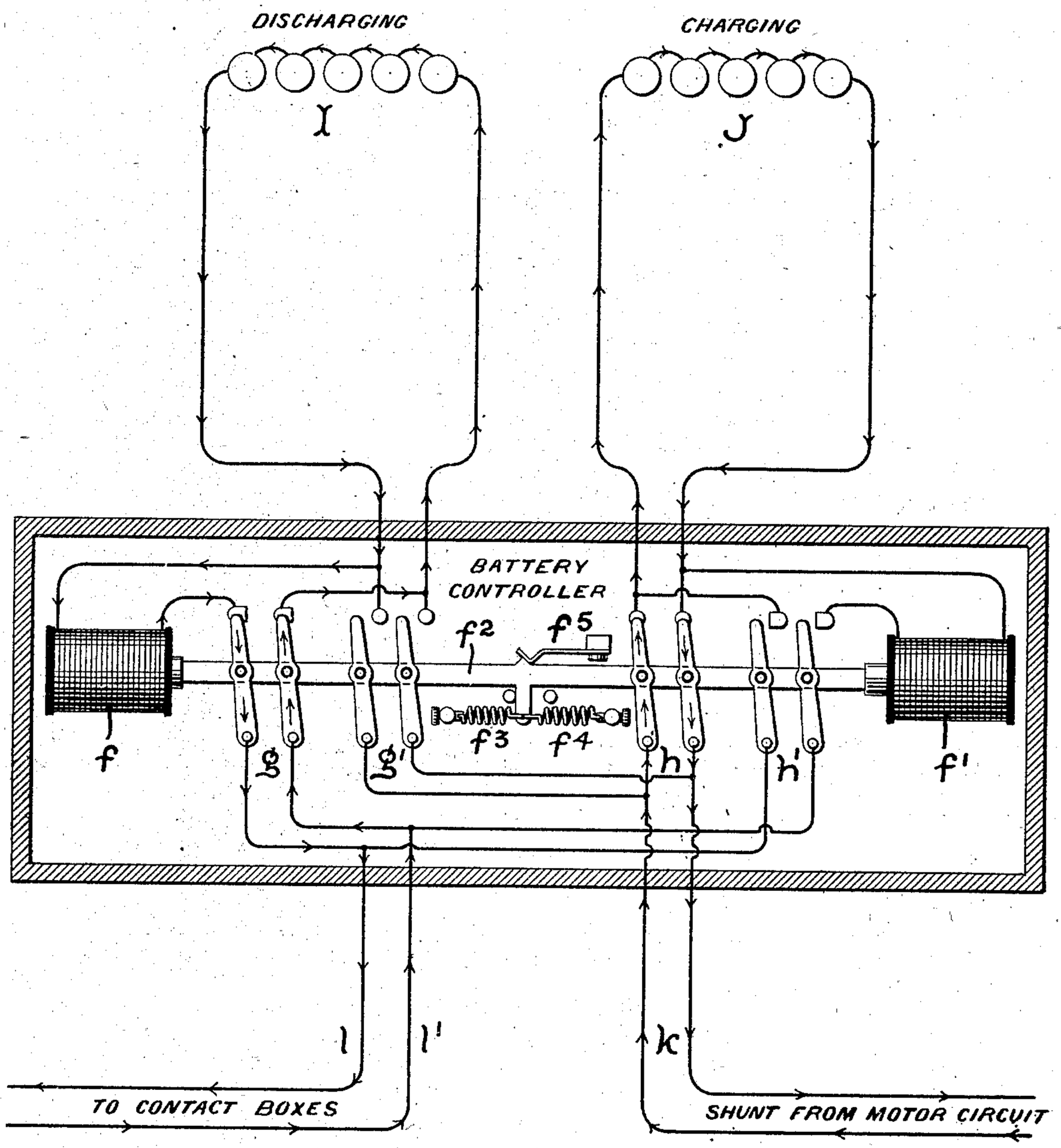
NO MODEL. 4 SHEETS—SHEET 4.

FIG. 4.



Witnesses
H. W. Lloyd.
A. Macdonald.

Inventor
Frank M. Ashley,
By his Attorney Albert G. Davis

UNITED STATES PATENT OFFICE.

FRANK M. ASHLEY, OF BROOKLYN, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 719,983, dated February 10, 1903.

Application filed February 26, 1898. Serial No. 671,792. (No model.)

To all whom it may concern:

Be it known that I, FRANK M. ASHLEY, a citizen of the United States, residing at Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Electric Railways, of which the following is a specification.

This invention relates to electric railways of that class in which the working conductors are located either upon or below the surface of the road-bed.

It also relates to systems wherein are used sectional working conductors, which are cut into and out of circuit as the car moves along by means of electromagnetic devices.

My invention consists in providing upon each car a storage battery or batteries, which are charged by the main current and the current from which is used to operate the electromagnetic switching devices.

The invention also comprehends the means whereby the current from said batteries is successively sent through and withdrawn from the electromagnetic switching devices in the system.

In the accompanying drawings, Figure 1 is a diagrammatic view of the circuits and apparatus of my invention when the main rails are utilized to carry the battery-current. Fig. 2 is a similar representation of a system in which four sets of batteries are used. Fig. 3 is a diagram of a system in which the battery-current is sent through supplemental sectional rails and the main current is sent through one line of sectional rails and returned through the ground. Fig. 4 is a detailed view of the automatic battery-switch.

Referring now to Fig. 1, it will be seen that the main rails A A are divided into sections, which are insulated from each other. In the road-bed the main and return conductors B B are buried, and between the main rails are placed two lines of sectional rails $b\ b'$. These two sectional rails are energized by means of solenoids S, located in boxes in the road-bed. The cores of the solenoids carry contact-points s, which control the circuit in two branches leading, respectively, from the main wires B B to the sectional rails $b\ b'$. The car carries trolleys T T'. The motor which propels the car is indicated by M, and wires $m\ m'$ lead from the trolleys thereto. The wheels of the car are indicated by W W', and those on each side are electrically connected together, while being insulated from the axles. The solenoids S are connected in wires p, extending from one corresponding section of the main rail A to the other—that is, the wire p bridges two sections of the main rails, and in the bridge the solenoid is connected. The car carries two sets of storage batteries I and J. K is a battery-controller, to which the shunt k from the main circuit on the car is led, and from the battery-controller two wires $l\ l'$ lead, respectively, to the wheels on each side of the car. The battery-controller, Fig. 4, consists of two solenoids $f\ f'$, the cores of which are attached to a common bar f^2. Two springs f^3 and f^4 are arranged to oppose the pull of the magnets, respectively, and a spring-catch f^5 is used to hold the bar steady in either one of its positions. The bar is attached to four switches $g\ g'\ h\ h'$ and is adapted to move them all simultaneously. The shunt k from the motor-circuit leads to the switches h and g', and the wires $l\ l'$ lead to the switches g and h'. When the controller is in the position shown in the drawings, battery J is being charged and battery I is giving off current. When the current from battery I becomes too weak to do the work for which it is intended, magnet f, which is in circuit with said battery, is overcome by the force of the spring f^4 and the bar is pulled to its opposite position, thus throwing battery I into the charging-circuit and battery J into the working circuit. In operation as the car-wheels successively move from section to section of the main rails the current from one or the other of the storage batteries is sent through corresponding solenoids S, and the main circuit to the sectional conductors $b\ b'$ is thereby completed. Likewise the circuits are broken as the wheels leave the insulated sections. The wheels at the forward end of the car close the battery-circuit through a solenoid ahead before the main trolley leaves the rails immediately at the rear and also before the rear solenoid is de-energized.

In the system shown in Fig. 2 the battery-current leads through the main rails; but in

this instance the sectional working rails or conductors are substituted by metallic heads *q*, which form a part of the magnetic circuit of the solenoids and through which the main current is conducted. In this instance it requires two solenoids to accomplish what one does in Fig. 1, and the trolley instead of being formed of wheels or brushes is in the form of a shoe. In this system also four sets of storage batteries are used simultaneously, two sets being utilized to operate the solenoids ahead before the trolley leaves those at the rear, while the other two sets continue to energize the solenoids after the forward wheels have passed beyond a given section.

In Fig. 3 the main rails are not used for the battery-current at all; but special sectional rails *u u'* are placed in the road-bed for this purpose, and supplemental trolleys *t t'* are used in connection with them. The main current is taken from a single sectional rail *v* and returned through the ground.

By means of the invention herein described the magnets are never subjected to an excessive current and are therefore not liable to be burned out, and short-circuiting is not likely to take place. The amount of battery necessary to do this work is small, and the operation is entirely automatic. The batteries may of course be changed at the station, if desired, and primary batteries may also be used.

Having thus described my invention, I claim—

1. Means for automatically changing the connection of a load from one source of current to another when the strength of the first source diminishes, which comprises a switch connecting the load with the first source and disconnecting the two when the strength of the first source diminishes, a switch maintaining the circuit open between the load and the second source and connecting the two when the strength of the first source diminishes, an electromagnet-coil in series with the first source for holding the first switch closed and the second switch open and permitting the first switch to open and the second to close when the strength of the first source diminishes, and means independent of said coil for holding said switches steady in either their closed or open position.

2. In a controller, the combination with two sources of current, of a load, a switch for connecting the load with one source, a switch for connecting the load with the other source, a magnet-coil connected in series with the first source for maintaining the first switch closed and the second switch open, mechanical means tending when the first switch is closed to open the same and to close the second switch, and means independent of said coil for holding said switches steady in either their closed or open position.

3. Means for automatically alternating the connections of two storage batteries so that one is connected with the load while the other is being charged from the main, which comprises four switches for connecting each battery with the load and main, a coil in series with each battery for controlling all the switches, and mechanical means for automatically moving the switches when the strength of the current flowing through either coil diminishes, to permit the switches to come under the control of the other coil.

4. The combination in an electric railway, with line conductors, of working conductor-sections, supplemental conductors connected in pairs, and electromagnetic switches, each one connecting the line with one working section, the coils of the said switches being permanently included in the connections between the supplemental conductors.

5. The combination in an electric railway, with line conductors, of working conductor-sections, supplemental sectional conductors connected in pairs, a battery on the car adapted to be connected with the sectional pairs of supplemental conductors, and electromagnetic switches, each one connecting the line with one working conductor-section, their coils being permanently included in the sections between the supplemental conductor-sections.

6. In an electric railway, the combination with line conductors, of working conductor-sections, connections between the latter and the former, electromagnetic switches for said connections, and two batteries of secondary cells which are alternately and automatically charged from the line conductors, and discharged to energize said switches.

7. In an electric railway, the combination with line conductors, of working conductor-sections, connections between the latter and the former, electromagnetic cut-outs for said connections, two storage batteries carried by the car for energizing said switches, and means for automatically utilizing the batteries alternately.

8. In an electric railway, the combination with line conductors, of working conductor-sections, connections between the former and the latter, electromagnetic switches for said connections, two batteries of secondary cells for energizing said switches, and means for automatically connecting each battery in shunt to the motor-circuit, and with the circuit including the electromagnets alternately, when the strength of the battery energizing the switches is diminished.

9. The combination in an electric railway, with line conductors, of sectional main and return working conductors, supplemental sectional conductors connected in pairs, and electromagnetic switches, one for connecting the line with one main section, and one for connecting the line with one return-section, the coils of both being permanently included in the connection between the supplemental conductors.

10. In an electric railway, the combination with line conductors, of working conductor-

sections, electromagnetic switches for connecting the latter with the former, two batteries carried by the car for energizing said magnets, and means for automatically connecting the second battery in circuit when the strength of the first battery diminishes.

11. In an electric railway, the combination with line conductors, of working conductor-sections, electromagnetic switches for connecting the latter with the former, two batteries carried by the car, one connected with the supply-circuit and the other connected to energize the electromagnets, and means for reversing said connections when the strength of the battery energizing the magnets is diminished.

12. The combination with an electromagnetic core provided with contacts, of a pair of coils adapted to receive the ends of said core, means for opposing the pull of each magnet-coil, and means for removably holding said core in its opposite positions.

13. The combination with an electromagnet-core which serves as a switch-piece support, of two coils, each arranged to hold the core at one end of its travel, and mechanical means for automatically moving the core when the flow of current through the coil which is so holding the core, diminishes, to cut that coil out of circuit, and to connect the other in circuit, whereby the core is held by the other coil at the other end of its travel.

14. In a controller, the combination with two sources of current, of a load, switches for connecting said load with the two sources, magnet-coils, one in series with each source for maintaining the respective switches closed, a spring or springs tending when either of said switches is closed to open the same and to close the circuit of the other source through the other magnet-coil, and means independent of said coils for holding said switches steady in either their closed or open position.

15. In a controller, the combination with two storage batteries, of the load-circuit, a charging-circuit, switches for connecting the batteries with the charging-circuit and load, and magnet-coils, one in series with each battery, each coil being arranged to control all said switches, whereby the battery connections are alternated between the load and the charging-main.

In witness whereof I have hereunto set my hand this 13th day of November, 1897.

FRANK M. ASHLEY.

Witnesses:
WM. A. ROSENBAUM,
HARRY BAILEY.