(No. Model.)

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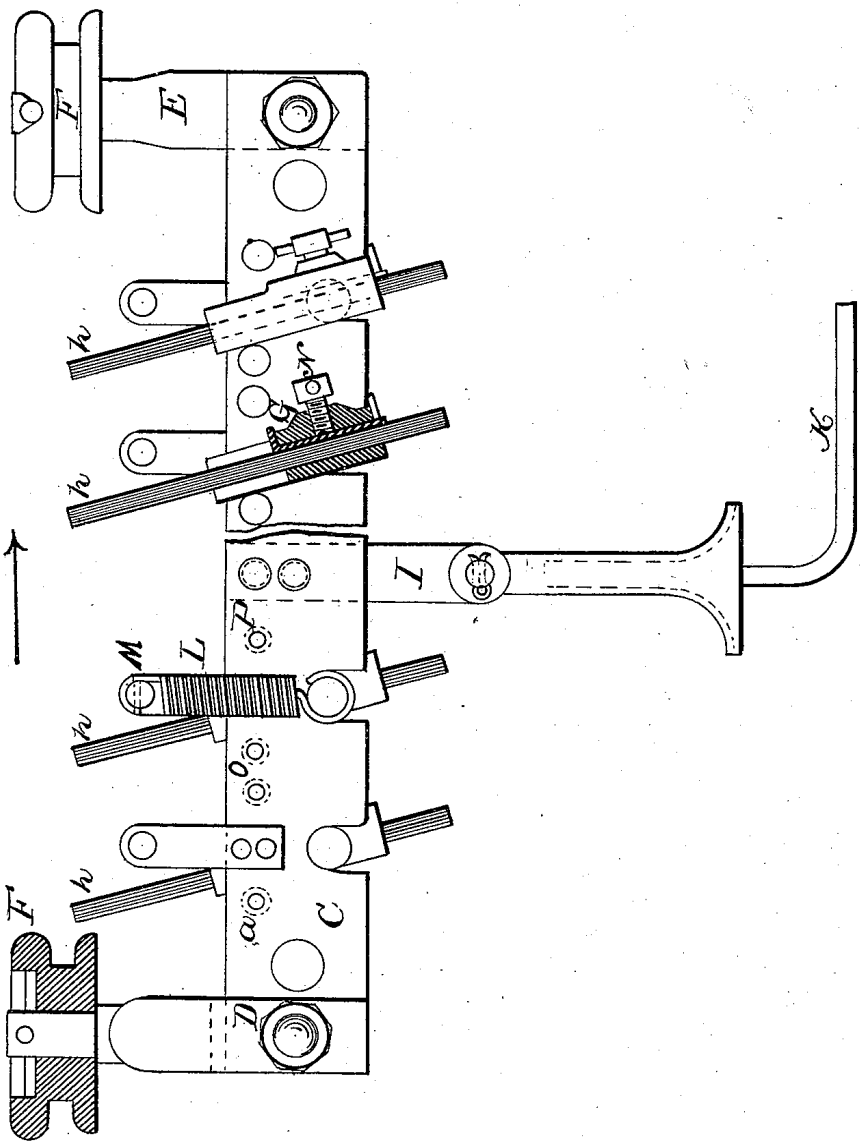
E. W. SIEMENS.

ELECTRIC RAILWAY.

No. 322,859. Patented July 21, 1885.

Fig 1.



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J. B. Lawyer

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(No Model.) 6 Sheets—Sheet 2.

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ELECTRIC RAILWAY.

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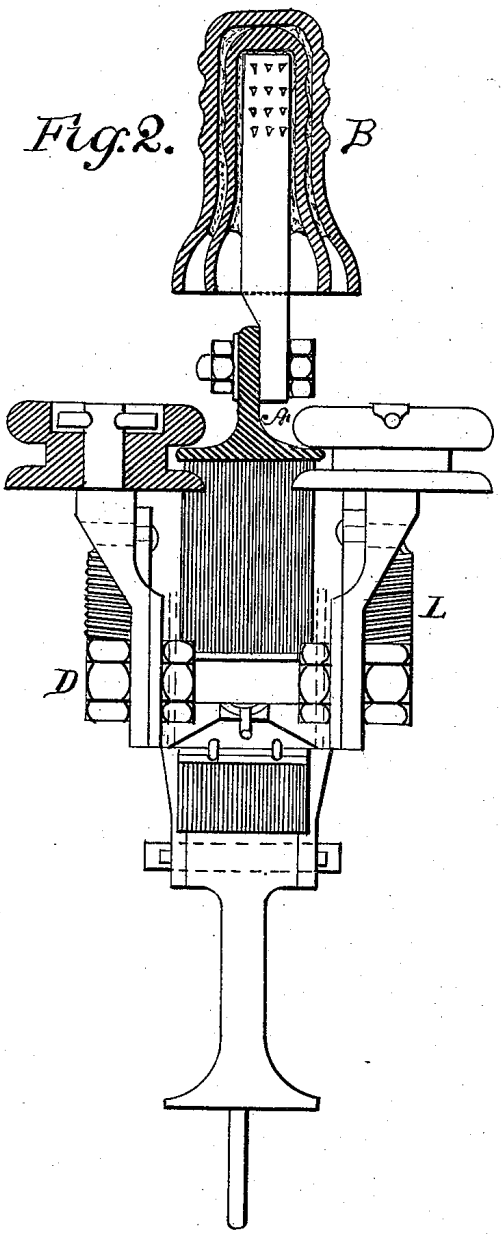
Fig. 2.



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(No Model.) 6 Sheets—Sheet 3.

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ELECTRIC RAILWAY.

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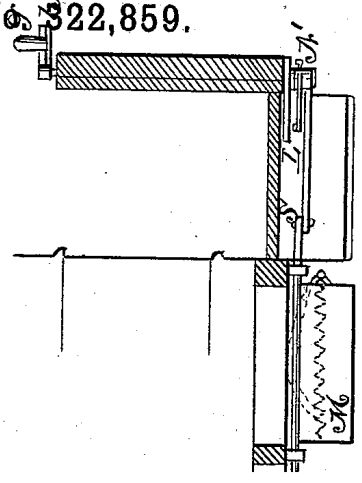

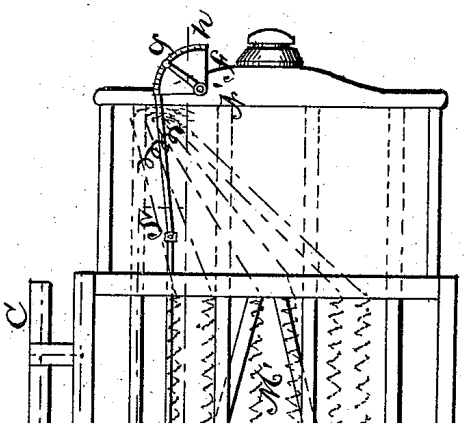

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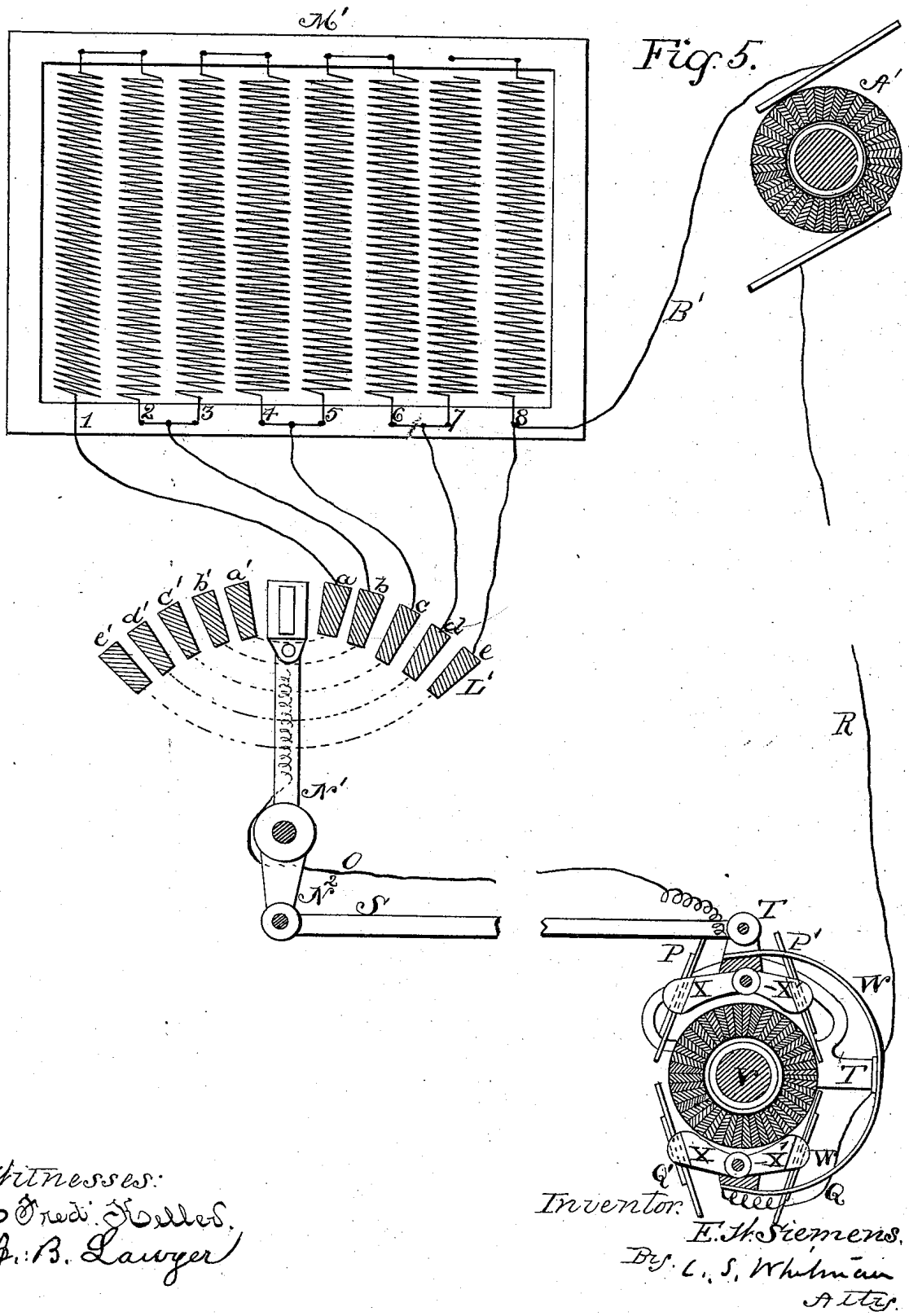
ELECTRIC RAILWAY.

No. 322,859. Patented July 21, 1885.

Fig. 5.



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(No Model.) 6 Sheets—Sheet 5.

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ELECTRIC RAILWAY.

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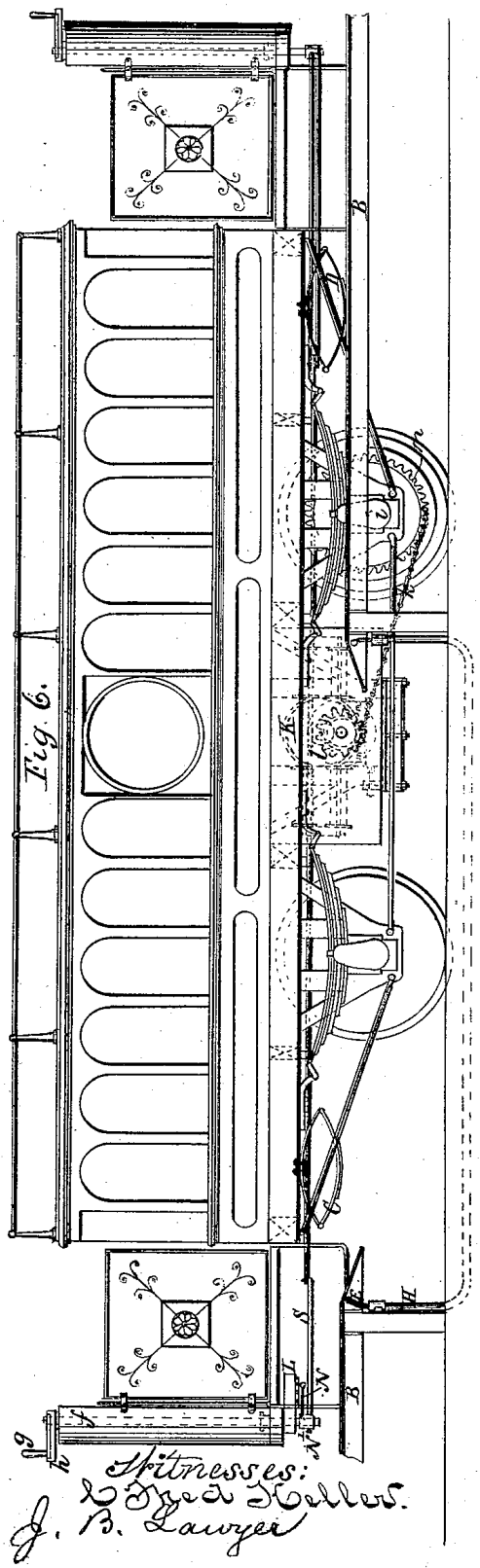

Fig. 6.

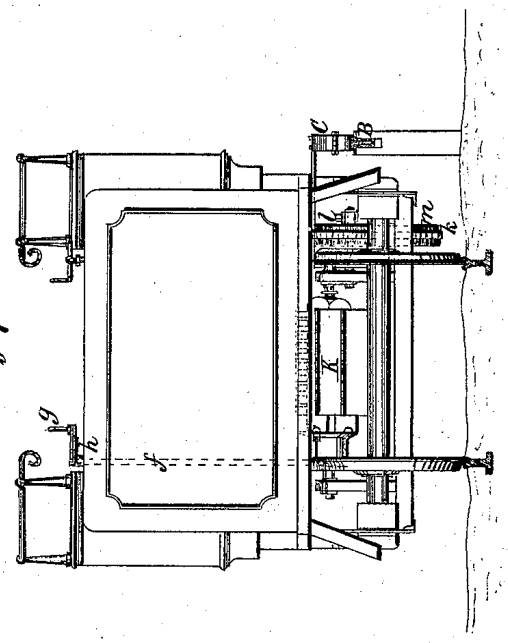

Fig. 7.

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ELECTRIC RAILWAY.

No. 322,859. Patented July 21, 1885.

Fig. 8.

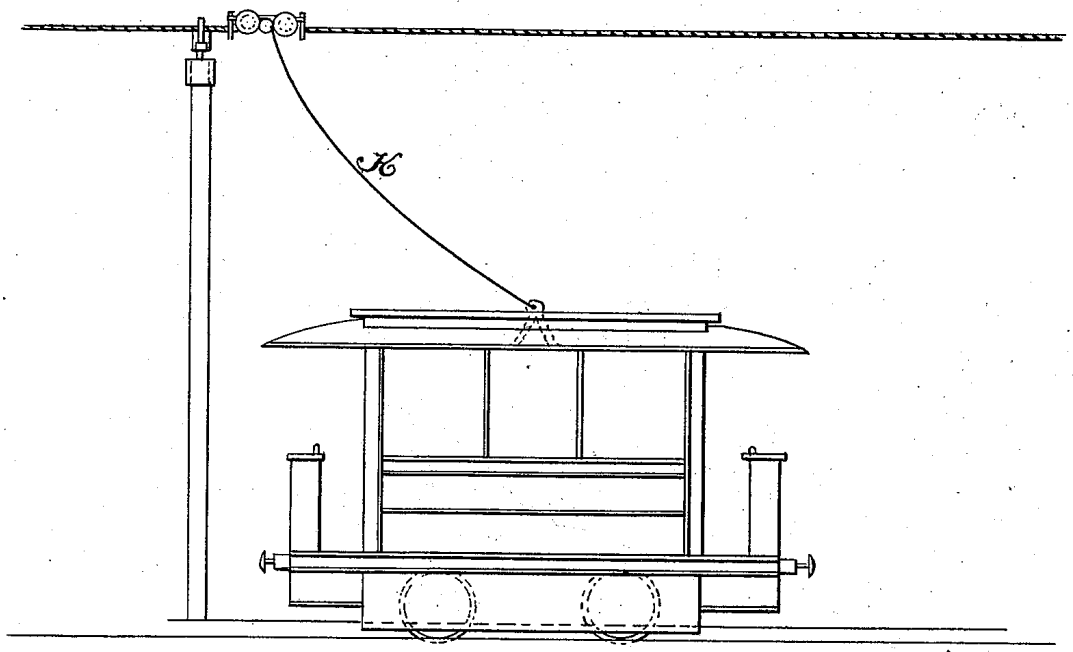
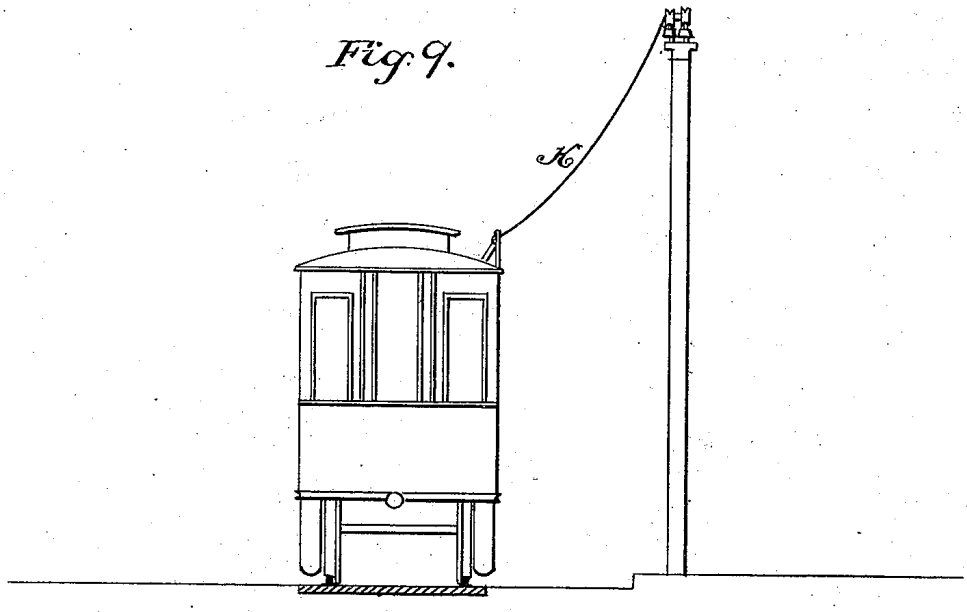


Fig. 9.



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UNITED STATES PATENT OFFICE.

ERNST WERNER SIEMENS, OF BERLIN, GERMANY.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 322,859, dated July 21, 1885.

Application filed April 8, 1885. (No model.)

To all whom it may concern:

Be it known that I, ERNST WERNER SIEMENS, a subject of the Emperor of Germany, residing at Berlin, in the German Empire, have invented certain new and useful Improvements in Electric Railways; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates to electric railways and to means and apparatus made use of for transporting persons and things by the electrical transmission of power; and the nature of my invention consists in the means used for conveying the electrical energy to or from the electro-dynamic motor mounted upon the vehicle to be moved. According to my invention the current is conducted by a rigid conductor fixed upon insulating standards. On this conductor or rail is placed a small contact-truck composed of a set of wheels which travel upon the rail and support the truck, and a set of adjustable and reversible spring-brushes so arranged as to secure a perfect contact with the rail.

In the accompanying drawings, in which corresponding parts are designated by similar letters, Figure 1 shows a side view, partially in section, of a contact-truck operating with a rigid conducting-rail according to my invention, and Fig. 2 is an end view of the same. Fig. 3 is a part side elevation of a car having my invention applied thereto. Fig. 4 is a plan of the under framing of the same; and Fig. 5 is a diagram showing the connections of the electrical current. Fig. 6 is a side, and Fig. 7 an end view, of the car. Figs. 8 and 9 illustrate a method of electrically connecting a traveling truck with a moving car.

The iron or steel conducting-rail A, in connection with the stationary dynamo-electric machine, is suspended by suitable insulators, B, from standards along the line or from the roof of a tunnel. The truck consists of two side cheeks, C C, fixed together at a certain distance apart by bolts D, and having uprights E at their ends, that carry grooved rollers F, by means of which the truck is supported on the rail.

G G are sockets, in which are secured the contact-brushes *h h*, that press against the under surface of the conducting-rail A, so as to carry the current from the latter to the frame of the truck, from which it is led to the pendent socket I, in which is secured the flexible conductor K, leading to the railway-carriage. In order to insure perfect contact between the brushes *h h* and the rail, the sockets G G are pressed upward by means of springs L, connected at the upper ends to brackets M on the frame, and at their lower ends to side pins on the sockets G. The brushes are also adjustable in the sockets by means of clamping-screws N. When the truck travels in the direction of the arrows, Fig. 1, they will assume the angular position shown, being held in that position by stops *o*. On the motion of the carriage being reversed, the brushes will of themselves assume a reversed inclined position, being held then by stops P P.

The locomotive made use of by me at the city of Berlin in the year 1879, which is described in another application, consisted of a vehicle with four wheels which were rigidly fastened to their axles, and a frame-work which carried the bearings of the driving-axles, the electro-dynamic motor, and the supports for the axle of such wheels as were required to produce the required ratio of velocity between the fast-running axle of the electro-dynamic motor and the comparatively slow-running axles of the driving-wheels. The metallic parts of the electro-dynamic motor were electrically insulated from the metallic parts of the frame-work, and the electrically-conducting communication through the toothed wheels between the motor and the frame was broken by applying an insulating-piece in one of the toothed wheels. The four wheels of the locomotive were in conducting-connection with the frame, and also in connection, through the rails, with the stationary dynamo-electric machine. Between the two rails upon which the vehicle traveled a middle rail, insulated upon wood or in any other proper manner, was made use of for transmitting the current, and both of the track-rails were made use of for the return-current. The electrical connection between the rail running in the middle between the two track-rails and the electro-dynamic motor of the locomotive was

effected by means of metallic brushes attached to the car-frame in an insulated manner, and the gap in the circuit thus formed between the brushes and the frame was closed by the copper wire of the electro-dynamic motor, and by a switch provided with artificial resistances by leading an insulated wire from the brushes upon the rail to one of the poles of the electro-dynamic motors of the locomotive, and another insulated wire from the frame through the switch to the other pole of the motor.

According to my present invention, a conducting-rail is placed above the track and in conductive communication with the stationary dynamo-electric machine. The rails upon which the car moves are joined by copper staples, and form the return-circuit, and the current is conveyed to the car by the flexible conductor K, which may be attached to the side of the car, as shown in Figs. 8 and 9, or to the top. From the flexible conductor K the current is taken to a commutator by a lever, which switches resistance-frames placed under the car in or out, as may be desired, and also changes the position of the brushes on the commutator of the electro-dynamic motor, and thus reverses the direction of its motion.

In starting the locomotive the current is not turned on suddenly, but is made to pass through the resistances, which are afterward cut out in part or altogether, according as the conductor chooses to run fast or slow. The current is conveyed from the electro-dynamic motor through the axle-boxes to the axles, and from thence to the tires of the wheels, and finally led by the insulated track-rails to the stationary dynamo-electric machine, as shown by dotted lines at Z, Fig. 4.

The parts of the conductor may be connected by fish-plates, and also by double copper loops securely soldered to the iron, and the track-rails are connected in a similar manner.

The electro-dynamic motor K is placed beneath the floor in the center of the car, and by means of intermediate spur-gear drives one axle only, and the levers working the mechanical brakes and also the reversing-levers are connected to both ends of the car, so that the conductor can always stand in such a position as to have an uninterrupted view of the rails.

In Fig. 5, A′ represents the stationary dynamo-electric machine, from which the current passes by the conductor B′, which represents the conducting-rail A, previously described, and through the before-mentioned brushes to the switch L′ and resistance-frames M′ upon the car. It will be seen that the resistances 1 2 3 4, &c., are connected together in series, while connection is made from resistance 1 to contact-plate *a* of the switch; from the junction of resistances 2 and 3 to plate *b;* from the junction of 4 and 5 to plate *c;* from the junction of 6 and 7 to plate *d*, and from resistance 8 to plate *e*. The contact-plates *a′ b′ c′ d′ e′* are connected, respectively, to *a*, *b*, *c*, *d*, and *e*, so that when the contact-lever N′ is moved to the same angular position on either side of the central position it makes the same contacts. From the contact-lever N′ a conducting-wire, O, leads to the one pair of brushes P P′ of the commutator of the electro-dynamic motor on the car, while from the other pair of brushes, Q Q′, a conductor, R, representing the wheels of the vehicle and rails, leads the current back to the dynamo A′. An extension, N^2, of the lever N′, is connected by a rod, S, to a frame, T, pivoted on the axis V of the electro-dynamic machine, which frame carries spring-arms W, the ends of which are made to slide with a certain pressure upon the arms X, that carry the contact-brushes, and that swing on pins X′, fixed to the dynamo-frame. Thus on shifting the contact-lever N′, say to the right from the central position, the frame T will be moved so as to cause the arms W to bring the brushes P and Q in contact with the commutator; and immediately upon such contacts being made, the lever N will be brought on to the contact-plate *a*, so that the circuit from B will now pass consecutively through all the resistances in the direction from 8 to 1, and thence through plate *a* and wire O to the commutator, causing the dynamo-machine to rotate in the direction determined by the position of the contact-brushes, the current being, however, of comparatively little strength. On moving over the lever N successively to the plates *b*, *c*, *d*, and *e*, the strength of the current will be successively increased by reason of the resistances 1 2 3, &c., being successively cut out of the circuit until, when contact is made with plate *e*, the whole of the resistances are thus cut out, and the full strength of the current is made to pass through the machine, which thus will propel the car at full speed.

For slacking the speed the lever is moved back to the contact-plates *d*, *c*, *b*, or *a*, according to the speed required, thereby introducing the corresponding resistances into the circuit, while for reversing the direction of motion of the electro-dynamic motor, and consequently of the car, the lever is moved over to the left of the central position, whereby, first, the frame T and arms W will be moved so as to bring the brushes P Q out of contact, and those P′ and Q′ in contact with the commutator, after which, by the continued motion of the lever onto the contact-plates *a′ b′*, &c., the strength of the current will be gradually increased by the successive elimination of the resistances.

Thus it will be seen that in stopping and starting the car motion will be very gradually decreased and increased, while in reversing the position of the commutator-brushes there will be little or no objectionable sparking, as the lever will have been moved to the central position in which the current from B will be interrupted by the time the brushes are brought out of contact, as shown on the drawings.

Figs. 3 and 4 show the actual arrangement of the stopping, starting, and reversing gear

upon the car. *f' f* are vertical spindles at each end of the car, provided at their upper ends with crank-handles *g g*, moving over graduated quadrants *h h*, while at their lower ends they are connected by levers N' to the rod S, passing along underneath the car, and connected by a link, S', with the before-mentioned rocking frame T of the commutator V of the electro-dynamic motor K, supported at the middle of the car-framing by suspended bearers. The spindle *f*, at the right-hand end of the car, also carries at its lower end a contact-lever, N', the end of which, on the rotation of the spindle in one direction or the other, makes contact with one or other of the plates *a b c d e*, &c., of the switch L', which plates are connected to resistances, as described with reference to Fig. 5, and which may be placed at any convenient part of the car. The divisions on the quadrant *h* being made to correspond with the contact-plates *a b c d e*, &c., it will be seen that according as the driver moves his handle *g* to one or other of these divisions he will effect the stopping, starting, or reversing of the motion of the car, or will vary the speed with which it travels.

The lever N' makes contact with a conducting-wire leading to the one pair of the commutator-brushes, while the other pair of brushes is electrically connected through another wire and the axles and wheels of the car with the permanent way serving as the return conductor.

The motion of the dynamo-axis is communicated to the axle by means of a pitch-chain passing over a small pitch on the dynamo-axis and a larger pitch-wheel on the axle.

The car herein described is the same in all respects as that described in another application filed by me on the 9th day of December, 1884, except that the pole of the electro-dynamo motor is connected to a pendent conductor, K, instead of being connected to a spring at the side of the vehicle. I therefore do not desire to secure by Letters Patent anything described herein which is claimed in the said application filed December 9, 1884.

Having thus described my invention, I claim and desire to secure by Letters Patent of the United States—

1. The combination of the suspended rail, the contact-truck having brushes that press against the under surface of the conducting-rail, and the pendent socket having a flexible conductor leading to the railway-carriage.

2. In an electric railway, the combination of a conducting-rail with a smooth under surface for the contact-brushes, connected with a stationary dynamo-electric machine, and an insulator from which the conducting-rail is suspended.

3. The contact-truck consisting of two side cheeks, C C, connected by bolts D, and uprights E, provided with grooved rollers F, as and for the purposes described.

4. The combination of the contact-truck having sockets G, and stop-pins, *o*, with brushes adjusted by clamping-screws, as and for the purposes described.

5. In an electric railway, the combination, with a rail connected with a stationary dynamo, of a series of brushes mounted in a traveling truck, and having springs which cause them to press against the side of the rail, as and for the purposes described.

6. The combination, with a rail connected with a stationary dynamo-electric machine, of a truck movable upon the rail, and having grooved rollers which travel upon the edge thereof, as and for the purposes described.

7. The combination of a rail, connected with a stationary dynamo-electric machine, with a truck provided with sockets in which are secured contact-brushes that press against the under surface of the rail, so as to carry the current from the latter to the frame of the truck.

8. The combination, with a conducting-rail, of a contact-truck having reversible brushes provided with springs and stops, as and for the purposes described.

9. In an electric railway, the combination of one or more stationary dynamo-electric machines, a movable car having an electro-dynamic motor mounted thereon, a conductor arranged above or at the side of the movable car or vehicle, and a branch conductor provided with a contact-truck having reversible brushes in electrical contact with the conductor and electrically connected with the motor, as and for the purpose described.

10. The combination of a conducting-rail electrically connected with one pole of a dynamo-electric machine, a traveling contact-truck provided with reversible brushes, an electro-dynamic motor electrically connected with the contact-truck and mounted upon a movable car, axle-boxes electrically connected with the motor, wheels the axles of which revolve in the axle-boxes, and rails supporting the wheels and electrically connected to the stationary dynamo-electric machine, as and for the purposes described.

11. The combination, substantially as herein set forth, of an electro-dynamic motor mounted upon a movable vehicle, a circuit-controlling lever capable of closing the circuit upon the commutator of the motor to produce either forward or backward motion of the motor, and a traveling contact-truck provided with reversible brushes electrically connected with the motor, as and for the purposes described.

12. The combination, substantially as herein shown, of an electro-magnetic motor and its commutator, with two sets of contact-brushes electrically connected with a traveling contact-truck having self-reversing brushes, one set of contact-brushes being so adjusted as to produce rotation of the motor in one direction, and the other set so adjusted as to produce rotation in an opposite direction.

13. The combination, in an electric railway, substantially as herein described, of an electrical dynamic motor, two sets of contact-

brushes, a lever adapted to throw either one of the two sets of contact-brushes into contact with the commutator, and the other set out of contact therewith, and a contact-truck having reversible brushes connected to the car, whereby a single movement of the lever reverses the direction of travel of the car.

14. The combination of an electro-dynamic motor and its commutator, two sets of contact-brushes, a lever capable of being placed in a position for throwing the brushes for producing a direct motion into contact with the commutator, of removing all contacts from the commutator, and of throwing brushes for producing a reversed motion of the motor into contact with the commutator, and a contact-truck having reversible brushes connected to the car upon which the motor is placed, as and for the purposes herein described.

15. The combination, substantially as herein set forth, of an electro-dynamic motor and its commutator, two sets of commutator-brushes, adjusted respectively to produce direct and reversed motion of the motor, a reciprocating rod or bar, operated by levers attached at each end thereof, and a contact-truck provided with reversible brushes attached to a car.

16. The combination, substantially as herein set forth, of an electro-dynamic motor and its commutator, two sets of commutator-brushes arranged to produce either a direct or reversed motion of the motor, a sliding rod or bar adapted to throw one set of brushes into contact with and the other set out of contact with the commutator, devices for adjusting the position of the shifting or sliding bar, and a traveling contact-truck provided with reversible brushes electrically and mechanically connected to a car.

17. The combination, substantially as herein shown, of an electro-dynamic motor and its commutator mounted in a depending frame beneath the car with two sets of commutator-brushes, one of which is so adjusted in relation to the commutator as to produce rotation of the motor in one direction, and the other of which is so adjusted as to produce rotation in the opposite direction and a contact-truck provided with brushes which reverse themselves when the direction of the motor of the car is changed.

18. The combination, substantially as set forth, of an electro-dynamic motor and its commutator, supported by suspended beams, two sets of contact brushes or devices, respectively adjusted to produce direct and reverse motion, a shifting-rod passing along underneath the car and connected with the rocking frame of the commutator-brushes, and a contact-truck traveling upon a conductor and provided with brushes which reverse themselves when the direction of the motion of the car is reversed.

19. The combination, substantially as set forth, of an electro-dynamic motor and its commutator, suspended by beams from the bottom of the car, two sets of contact-brushes or devices, respectively adjusted to produce direct and reversed motion, a shifting-rod passing along underneath the car and connected with the rocking frame of the commutator-brushes, vertical spindles at each end of the car connected by levers with the shifting-rod, and a traveling contact-truck having reversible brushes electrically connected to the contact-brushes of the commutator.

20. The combination, substantially as herein set forth, of an electro-dynamic motor suspended by bearers from the bottom of the car, and having upon its axle a pitch-wheel, a large pitch-wheel upon the axle of the car-wheel, and a pitch-chain passing over the small pitch-wheel on the axle of the motor and the large pitch-wheel on the axle of the wheels, and a traveling contact-truck having reversible brushes, as and for the purposes described.

21. In an electric railway, the combination, substantially as herein set forth, of a frame suspended beneath the car, having resistances connected together in series, a series of contact-plates electrically connected together, a contact-lever which makes the same connection with the contact-plates when moved a certain distance in one direction as when moved a certain distance in a reversed direction, and a contact-truck having reversible brushes and electrically connected with the contact-lever.

22. The combination of the contact-plates a' b' c' d' e', connected, respectively, with the contact-plates a b c d e, the contact-lever N, which on being moved to the same angle of resistance on either side of its contact position makes the same contact, and the contact-truck having reversible brushes electrically connected to the contact-lever.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of September A. D. 1884.

ERNST WERNER SIEMENS.

Witnesses:
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