(No Model.)

R. M. HUNTER.

ELECTRIC RAILWAY CAR.

No. 445,144. Patented Jan. 20, 1891.

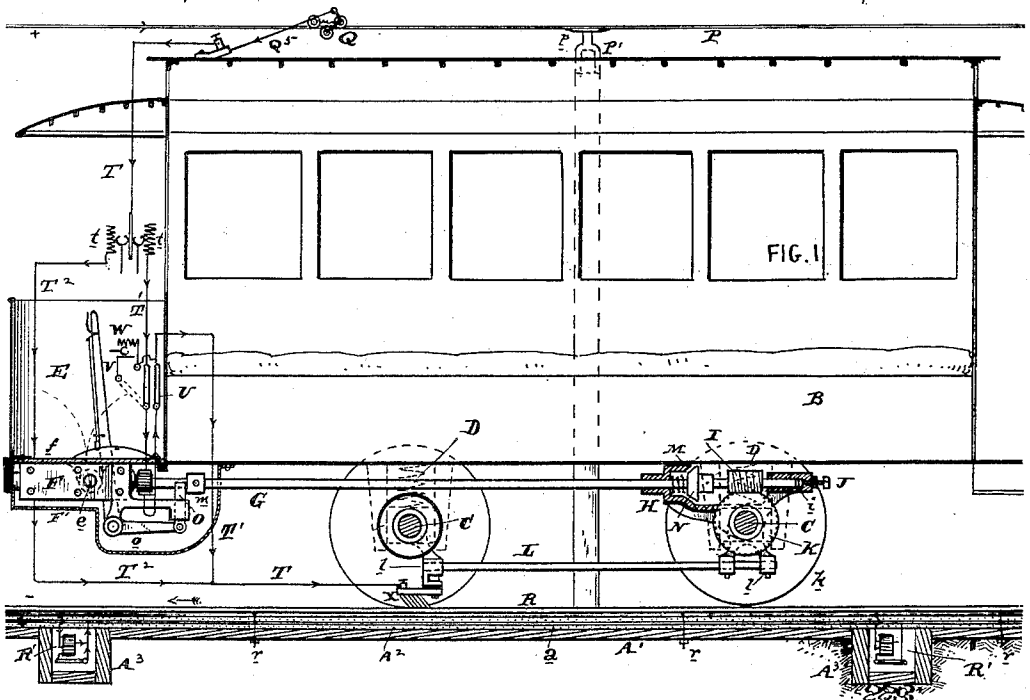


FIG. 1

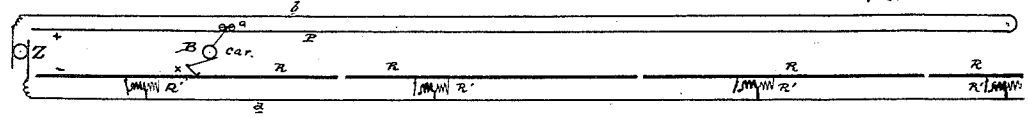


FIG. 2

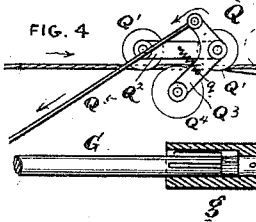


FIG. 4

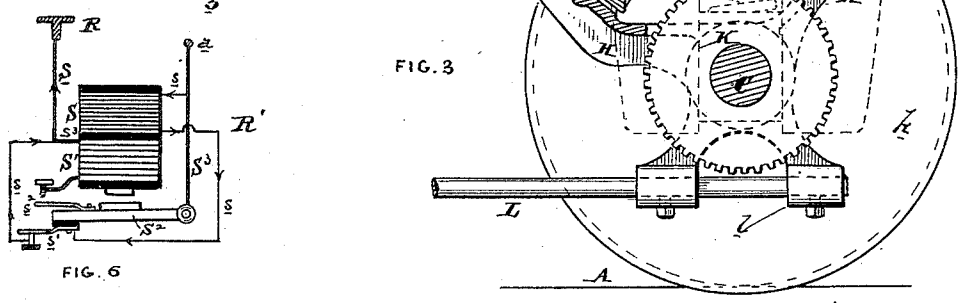


FIG. 3

FIG. 6

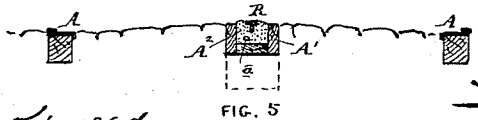


FIG. 5

Attest

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UNITED STATES PATENT OFFICE.

RUDOLPH M. HUNTER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE ELECTRIC CAR COMPANY OF AMERICA, OF SAME PLACE.

ELECTRIC-RAILWAY CAR.

SPECIFICATION forming part of Letters Patent No. 445,144, dated January 20, 1891.

Application filed October 4, 1886. Serial No. 215,199. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH M. HUNTER, of the city and county of Philadelphia, and State of Pennsylvania, have invented an Improvement in Electric-Railway Cars, of which the following is a specification.

My invention has reference to electric railways; and it consists in certain improvements, all of which are fully set forth in the following specification, and shown in the accompanying drawings, which form part thereof.

In applying an electric motor to an ordinary street or passenger car it has been the custom to support the motor on a frame suspended from the car-axles, so that the connection between the said motor and axles is fixed, no matter how much the car-body may rise and fall upon its springs. The disadvantage of this construction lies in the fact that the motor is necessarily located in a position in which it is difficult to attend to it, and defects are not readily perceived. Of course it has been proposed to mount the motor on the car-body and connect it by belts or chains with the axles; but such mechanical connections between the motor and axles are objectionable in many respects and will never be used to any extent.

My object is to provide a suitable construction whereby the motor may be positively geared or connected with the axles and yet be wholly supported by the car-body and be arranged under the driver's platform in the front of the car, whereby suitable trap-doors may be provided by which the motor may be easily inspected. In carrying out this part of my invention I provide, preferably, the rear axle with a worm-wheel and locate the motor under the front platform, as above explained. The motor-shaft is made to extend back, and is provided with a worm which meshes with the worm-wheel on the rear axle, whereby motion is imparted to the car. The rear end of this shaft is supported in bearings which are journaled upon the axle. It will now be evident that the ordinary movements to the car-body will not affect the motor-connection. This construction might be still more improved by supporting the motor on trunnions.

Another portion of my invention has reference to a brake device for an electrically-propelled car of the nature herein set out. In the construction of this part of my improvement I provide the motor-shaft with a conical brake-shoe which normally runs out of contact with a conical socket brake-surface. If the relative speed of the motor is slackened below that of the worm-wheel, the shaft is caused to move longitudinally and press the brake-shoe upon the brake-surface, arresting the rotation of the motor-shaft, and consequently the car-axle. This is an extremely simple and automatic device and effective in its action. When it is desired to run backward, this brake is prevented from coming into action by means of an adjustable thrust-block being thrown into position to prevent the longitudinal movement of the motor-shaft.

My object is also to provide a system of electric conductors which shall combine overhead and surface conductors, one being the positive and the other the negative. The overhead conductor is preferably the positive and the surface or underground conductor the negative. The surface conductor I prefer to make into sections, arranged upon the road-surface and combined with an embedded supply-conductor with automatic switches, which shall connect the supply-conductor with the section of working-conductor in connection with one of the collectors of the motor or car. By this means the negative working-conductor may be exposed on the surface of the roadway and have normally no injurious current passing through it; and, further, such method of normally cutting out the sections prevents undue leakage. The principle of these electric switches with sectional working-conductors and continuous-supply conductors is fully set out in my application filed June 21, 1886, and numbered 205,770. It is understood that the surface sectional conductor may be the positive and the overhead or suspended conductor the negative, if desired, though the former arrangement is preferable. The collector which travels on the suspended conductor is so constructed that it constantly grips the conductor with a fixed

pressure; but the instant an obstruction is reached—such, for instance, as the cable-support—the gripping action is automatically reduced to allow the wheel to separate sufficiently to pass over the said obstruction or enlargement. As soon as this is passed the normal grip is once more produced.

In the drawings, Figure 1 is a longitudinal sectional side elevation of an electric railway and an electrically-propelled passenger-car. Fig. 2 is a diagram illustrating the arrangement of circuits preferred. Fig. 3 is an enlarged sectional elevation of the motor-connection with the car-axle and brake, substantially as set out in Fig. 1. Fig. 4 is an elevation of the overhead collector. Fig. 5 is a cross-section of the road-bed, showing the surface conductor; and Fig. 6 is an elevation showing the construction of the electric switch for the section surface working-conductor.

A are the rails.

B is the car-body, and is supported upon the usual springs D.

C are the axles, and *k* the car-wheels. Upon the rear axle is secured a worm-wheel K.

F is the electric motor, which is preferably supported under the front platform E, and, if desired, hung to the car-body by trunnions *e*. In place of hanging the motor on trunnions, it might be rigidly connected. If the motor is under the platform, hinged doors *f* would be arranged over the same to allow of ready inspection of the motor either during running or when stopping. It is evident that the motor might be supported farther back under the car-body, if desired—for instance, over the front axle. The motor-shaft G extends rearward and is provided with a worm-wheel I, which meshes with the worm K on the rear axle. This shaft G is supported in the rear by bearings H, the rear one of which has thrust-disk *i* and an adjusting-screw J. The forward part of the bearing-frame H is provided with the conical brake-surface M, into which fits the conical brake-shoe N, which is secured fast to the shaft G on worm-wheel I. Normally the brake-shoe does not run in contact with the surface M, as the tendency of the worm is to draw the shaft G and its shoe N back, and this is still further insured by the spring *n*. From this construction it will be seen that when the car is being propelled forward the worm tends to move back and the shaft G works against the thrust-plates *i* in the rear bearing. If now it is desired to stop the movement of the car, the motor is slowed down, and as its speed is reduced there is a time when the tendency of the worm to rotate exceeds the tendency of the worm to rotate it. Hence the effect is to move the shaft G longitudinally sufficient to cause the shoe N to come into contact with the brake-surface M and tend to bring the car quickly to rest. This construction would enable a fast-speed worm to be used and would arrest the tendency of the worm-wheel to revolve the worm. The spring *n* tends to oppose the action of the brake-shoe, so as to assist in restoring the parts to their normal working condition. To prevent the brake being applied when the motor is reversed, a thrust-collar *m* is placed upon the shaft G and a thrust-block O is forced up in front of said collar by a hand-lever *o* before reversing the motor, and when running backward a simple movement of lever *o* to withdraw the block O will apply the brake. The shaft G may, if desired, be divided with a longitudinally-sliding coupling *g* to admit of the longitudinal action of the shaft in applying the brake without moving the armature to any extent. Such a coupling is shown in Fig. 3. The flexible connection *g* in the motor-shaft G and arranged between the motor F and the worm I, being formed with a grooved socket and feathers or keys upon the respective portions of the shaft, permits the longitudinal and lateral movement of the motor with respect to the worm without interfering with the proper running of the motor. It obviates all binding and compensates for the various movements that might take place to the motor with respect to the axle to which it is geared. This flexible coupling in the motor-shaft provides for all strains and twists which the shaft might sustain. Any other suitable flexible coupling device may be employed, if so desired, and it is obvious that this arrangement of motor and flexible shaft may be employed for transmitting power for various other purposes.

By the foregoing construction, if the car-body rides up and down upon its springs the movements will not affect the connection of the motor with the axle.

It will be observed that the vehicle-body is mounted on springs and to it the motor is connected so as to ride vertically, and by the bearing H and shaft G the motor is hinged to the axle, so that it may move concentrically with respect to the axle.

F is a dust shield or cover to protect the entire motor or working parts of same from the great dust raised by the car rushing over dirty streets. It is immaterial to my invention how this dust shield or cover for protecting the entire motor is formed or of what material it is made, and it is also to be understood that I do not limit myself to the location of this shield as being under the front platform, for it would be located about the motor no matter where said motor might be located upon the car. In many cases the protecting covering or shield to the motor would be located between the axles, and might be formed of metal, wood, or fabrics.

L is a longitudinal bar connecting two frames *l*, one on each axle to hold them in position, and to one of said frames is secured the collector-brush X, which makes contact with the surface conductor R. Any other form of collector may be used, if desired. The motor F is formed with its field-magnet cores and armature-shaft in substantially the same plane and extends across the car, being jour-

naled on each side of the car at e'. It will thus be seen that the motor is supported in swinging bearings beneath the car.

P is the overhead or suspended conductor carried upon shoes p at intervals apart, and which shoes are secured upon posts P'. This conductor may connect directly with the generator Z or source of electric energy, or may be connected therewith through a supply-conductor b, connecting the distant end of conductor P with the generator, whereby the line-resistance through the motor and return may be equal for all positions of the motor on the line, as set out in my application No. 171,625, of July 14, 1885, or No. 200,400, of April 28, 1886. The sectional surface conductor R may be made continuous or in sections, the latter being preferred. In cross-section it is preferably T-shaped and embedded in concrete or other suitable hard insulating material A^2, contained in a trough A', arranged parallel with the track and, if desired, between the rails thereof. The particular location is immaterial. The trough A' may be made of wood or metal, and, if desired, may be dispensed with.

In place of using a separate conductor, one of the rails may be used as a conductor. If the conductor R is made in sections, a supply-conductor a must be used connecting with the generator and connected at intervals with said sections of surface working-conductor by branches s, which may contain suitable switches R', to normally cut out said sections of working-conductor. The supply-conductor, if desired, may be embedded in the concrete, and the switches are located in suitable boxes or cases A^3, arranged in the roadway. The conductor-sections R may be held down by bolts r, which pass through the concrete and fasten to the bottom of the trough, or they may be simply held in the concrete, and the upper surface of the conductor is on a level with or a little above the concrete and is arranged with a concrete insulation on each side.

The preferred construction of switches R' is shown in Fig. 6, in which it will be seen that the working-conductor R and supply-conductor a are connected through a branch circuit s, including a high-resistance magnet S, having an armature S^2, which operates a spring circuit-breaker s' in said circuit s, whereby the high-resistance magnet may be cut in or out of circuit. S' is a low-resistance magnet, also acting upon armature S^2; but this low-resistance magnet is normally cut out of circuit. When, however, the armature S^2 is attracted, it operates a spring circuit-closer s^2, to close the circuit S^3 around the high-resistance magnet and simultaneously breaks the circuit s. The spring-contacts s' s^2 are so arranged that one contact is made before the other is broken, and vice versa. Normally no current is passing to the section R; but as soon as the car runs upon a section the current will flow, as indicated by arrows, Fig. 6, and the armature S^2 will be attracted, which on rising closes the circuit through the low-resistance magnet and then cuts the high-resistance magnet and the current passes in great strength to the working-conductor. In the construction shown in Fig. 1 the circuit-breaker s' is dispensed with.

The current is collected from the suspended conductor by a traveling truck Q, dragged after the car by a cable Q^5. This truck Q is shown in Fig. 4, and is shown as consisting of two wheels Q', connected together in a frame Q^2.

Q^4 is a gripping-wheel arranged upon the under side of the conductor and journaled in the bell-crank Q^3, which is in turn hinged or journaled to the frame Q^2 and drawn toward it, so as to grip the conductor between the wheels Q' and Q^4, by a spring q. The tugging-cable Q^5 connects with the free end of the bell-crank Q^3, and is so arranged that the line of tension or pull is somewhat below the axle of the leading wheel Q'. By this means the grip on the conductor will be constant. At the points of support or union of two ends of conductor there will be an enlargement, and to pass these enlargements without materially changing the degree of tension upon the conductor the wheel Q^4 must be somewhat lowered. This is accomplished by the pull upon the cable Q^5 by the car when the carriage Q is temporarily arrested by the enlargement, which increased pull oscillates the bell-crank Q^3 and lowers the gripping-roller Q^4. (See dotted lines, Fig. 4.) This enables the friction contact to be constant or practically constant at all times, and provides automatic means to positively operate the collector-carriage to quickly pass over obstructions.

T is the motor-circuit, and is subdivided into a circuit T', which includes the armature, and a circuit T^2, which includes the field-magnets of the motor F. Each of these circuits has its own independent resistance-changer t, and the armature-circuit T' has also a current-reverser U for reversing the motor. This enables a strong field to be used at starting, and a gradually-increasing armature strength, and as the motor approaches its maximum normal speed the field may be reduced. This enables a perfect working of the motor and embodies the construction set out in my application No. 214,309, filed September 23, 1886.

To use the motor as a braking-dynamo in the manner set out in my application No. 195,742, filed March 18, 1886, I provide a circuit V, having preferably a variable resistance W, which circuit may be cut in by switch U to short-circuit the armature of the motor, converting it into a dynamo. To stop the car it will only be necessary to cut in circuit V, short-circuiting the armature and offering a resistance to its rotation, which action would also apply the brake, as before set out.

While I prefer the construction herein shown, I do not limit myself to the details

thereof, as they may be modified in various ways without departing from my invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an electric railway, the combination of a car-truck, a car-body supported thereon by springs, an electric motor carried by the car-body, located below the floor and independent of the truck, connecting-gearing between the motor-shaft and axle of the truck, and a frame for the gearing and motor-shaft sleeved on the axle independent of the car-body.

2. In an electric railway, the combination of a car-truck, a car-body supported thereon by springs, an electric motor carried by the car-body and suspended below the floor in front of the forward axle of the truck and having its shaft arranged longitudinally on the car and below the floor thereof, and connecting-gearing between the motor-shaft and rear axle of the truck, also located below the floor of the car-body.

3. In an electric railway, the combination of a car-truck, a car-body supported thereon, an electric motor carried by the car-body and located wholly under the front platform, connecting-gearing between the motor and axle of the truck located below the car-body and independent of it, a regulator for the motor arranged upon the platform, and connecting-circuits between the regulator and motor.

4. In an electric railway, the combination of the car-truck, a car-body supported thereon, an electric motor carried by the car-body under the front platform independently of the axles of the truck, a door on said platform to expose the motor, and connecting-gearing between the motor and axle of the truck.

5. The combination of the car-axle, the car-body supported thereon, an electric motor supported by the car-body, a longitudinal bearing independent of the car-body for the motor-shaft, journaled upon and adapted to move concentrically with the axle to keep the end of the motor-shaft always in a fixed relation to the said axle, and connecting-gearing independent of the car-body between said shaft and axle.

6. The combination of the car-axle, the car-body supported thereon by springs, an electric motor supported by the car-body, bearings for the motor-shaft independent of the car-body, adapted to move concentrically with the axle to keep the end of the motor-shaft always in a fixed relation to the said axle, and connecting-gearing independent of the car-body between said shaft and axle.

7. The combination of the car-axle, the car-body supported thereon, an electric motor pivoted or hinged below the car-body, a motor-shaft adapted to move concentrically with the axle to keep the end of the motor-shaft always in a fixed relation to the said axle, a bearing arranged below the car-body and supported on the axle independent of the car-body to support the end of the motor-shaft, and connecting-gearing between said shaft and axle.

8. The combination of the car-axles, the car-body supported thereon by springs, an electric motor arranged under the forward platform, a motor-shaft extending obliquely rearward to the rear axle, a bearing for said shaft on the axle to hold it a given distance from the axle, and connecting-gearing between said axle and shaft.

9. The combination of the car-axles, the car-body supported thereon, an electric motor arranged under the forward platform, a motor-shaft extending rearward to the rear axle, a bearing for said shaft on the axle to hold it a given distance from the axle, connecting-gearing between said axle and shaft, and a removable platform over the motor.

10. The combination of the car-axles, the car-body supported thereon by springs, an electric motor arranged under the forward platform, a motor-shaft extending rearward to the rear axle, a bearing for said shaft on the axle to hold it a given distance from the axle, connecting-gearing between said axle and shaft, and an adjustable thrust-box at the rear end of the motor-shaft.

11. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, and a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface.

12. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface, and a movable thrust-bearing to prevent the longitudinal movement of the motor-shaft.

13. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface, a movable thrust-bearing to prevent the longitudinal movement of the motor-shaft, and a hand-lever to operate the thrust-bearing.

14. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary thrust-bearing at one end, a spring to press the shaft against said bearing, and a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface.

15. The combination of the motor, the car-axles, a longitudinally-movable jointed mo-

tor-shaft, the two parts thereof being connected by a sliding coupling, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, and a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface.

16. The combination of a motor, a vehicle propelled thereby, a mechanical connection between the motor-shaft and axle of the vehicle, and a brake-shoe actuated by the motor-shaft placed so that the brake is put into action when the revolution of said shaft is slowed down.

17. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface, a source of electric energy, and means to reverse the current in the motor.

18. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface, a source of electric energy, a motor-circuit, and means to short-circuit the armature to make the motor act as a generator and assist the mechanical brake.

19. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface placed so that as the motor slows down the brake-shoe is thrust against the brake-surface, a source of electric energy, a motor-circuit, means to short-circuit the armature to make the motor act as a generator and assist the mechanical brake, and a resistance-changer in said armature-circuit.

20. In an electric car or vehicle, the vehicle axle having a fixed vertical relation to the earth, in combination with a motor having its body supported on springs independently of the axle, but connected thereto so that it may move in the arc of a circle about said axle, and connecting-gearing supported by the axle independently of the motor-support and arranged between the axle and motor-shaft.

21. In an electrically-propelled vehicle, the combination of the vehicle axle, a frame supported upon the axle with provision for vertical movement and also capable of moving upon the axle as an axis, an electric motor having its field-magnets connected to the frame and being also hinged to the axle through said frame and the motor-shaft and gearing, and connecting-gearing between the motor shaft and axle.

22. In an electrically-propelled vehicle, the combination of the vehicle-axle, a frame supported upon said axle through the mediation of springs with provision for vertical movement and capable of moving upon the axle as an axis, an electric motor having its field-magnets connected to the frame and being hinged to the axle through the said frame and the motor-shaft and gearing, connecting-gearing between the motor-shaft and axle supported independently of the frame, and circuits and regulating apparatus carried upon the vehicle for controlling the current leading from the source of electrical energy to the motor.

23. In an electric car, the combination of the axles, a frame supported upon said axles, an electric motor positively and directly connected to one axle through the shaft and gearing and movable with respect to the other axle, whereby it may move in the arc of a circle about the axle to which it is connected and vertically with respect to the other axle, and an elastic support for the motor, whereby its weight is elastically supported and sustained by both axles.

24. In an electric railway, the combination of a suspended conductor, a collector-truck adapted to run thereon and consisting of one or more wheels provided with grooves resting against the said conductor, a pivoted arm connected to the frame carried by said first-mentioned wheel or wheels, a spring connecting the pivoted arm with the said frame, a grooved collector-wheel carried by the free end of said pivoted arm and movable against the conductor upon the side opposite to the first-mentioned wheels, a traveling vehicle, and a connecting-conductor connecting the collector with the vehicle.

25. In an electric railway, the combination of an electrically-propelled vehicle, a suspended working-conductor, a collector-truck adapted to run thereon, provided with a pivoted spring-lever carrying a tension-wheel, and a connecting-conductor connecting the spring-lever of the collector with the vehicle.

26. The combination of the electrically-propelled vehicle with suspended working-conductor P, collector Q, consisting of truck Q^2 and its wheels Q', pivoted lever Q^3, carrying tension-roller Q^4, spring q, and conductor Q^5, connecting the lever Q^3 with the traveling vehicle.

27. In an electric railway, an electrically-propelled vehicle, in combination with a suspended conductor, a gripping collector-truck running upon said conductor and provided with spring-pressed gripping-rollers, and a towing-conductor connecting it with the vehicle and directly acting against the spring of the gripping portion of the collector, the said devices working to automatically reduce the gripping action when the collector meets with obstructions or excessive resistance.

28. In an electric railway, the combination of an electrically-propelled vehicle, a motor

arranged below the car-floor, and a dust-case independent of the motor, inclosing said motor or the working parts thereof.

29. The combination of the motor, the car-axles, a longitudinally-movable motor-shaft, a worm and worm-wheel connection between the said shaft and axle, a brake-shoe carried by the shaft, a stationary brake-surface so placed that as the motor slows down the brake-shoe is thrust against the brake-surface, a movable thrust-bearing to prevent the longitudinal movement of the motor-shaft, a source of electric energy, and means to reverse the current in the motor.

30. In an electrically-propelled vehicle, the combination of a worm-wheel on the axle, a motor, a loose shaft-connection between the motor and worm, so that the motor may move longitudinally independently of the worm, and independent supports for the motor and worm.

31. In an electrically-propelled vehicle, the combination of the axles, a spring-support on the axles, an electric motor carried by the spring-support, a flexible motor-shaft having one end connected to the motor and the other end connected to the axle through gearing, gearing between the motor-shaft and axle, and a frame carried by the axle independent of the spring-support for holding the end of the flexible shaft and gearing in a fixed relation to the axle.

In testimony of which invention I hereunto set my hand.

RUDOLPH M. HUNTER.

Witnesses:

RICHD. S. CHILD, Jr.,

E. M. BRECKINREED.