(No Model.)

2 Sheets—Sheet 1.

T. A. EDISON.

ELECTRIC RAILWAY.

No. 475,494. Patented May 24, 1892.

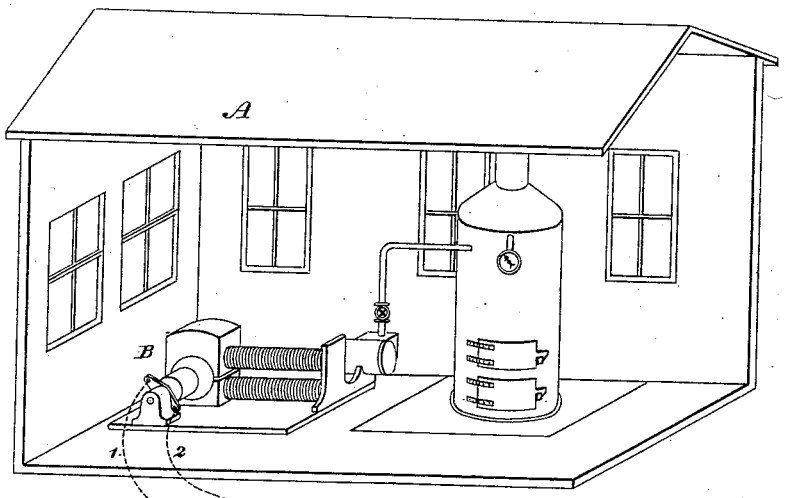
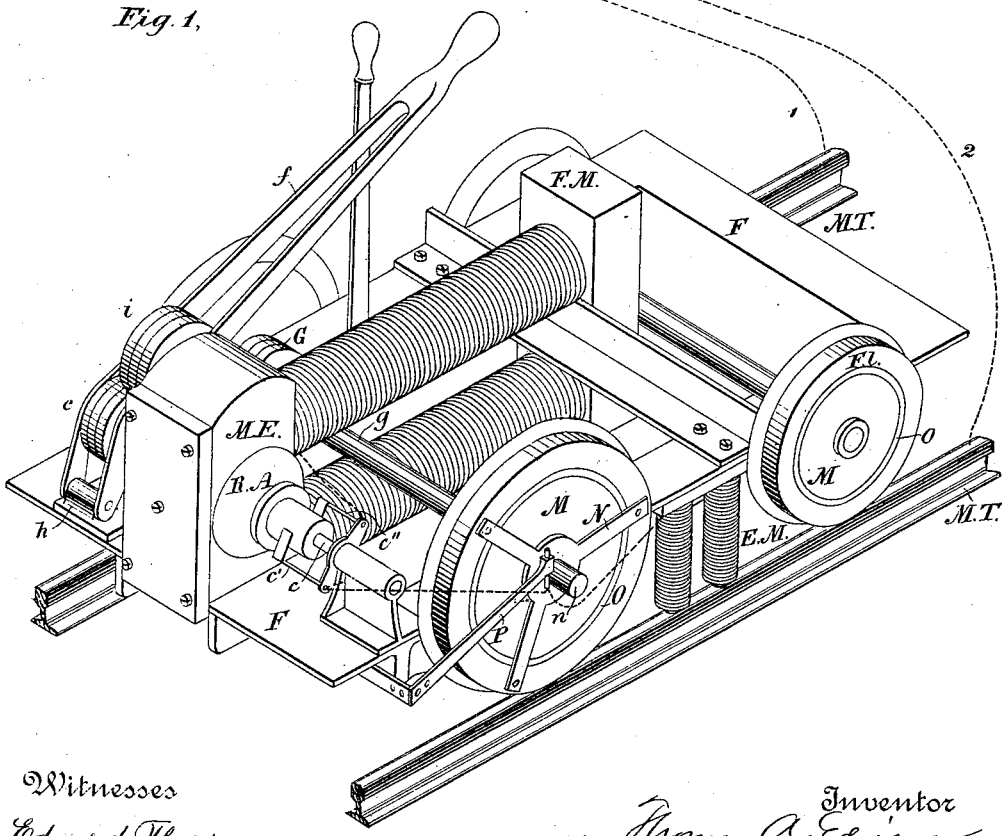


Fig. 1.



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(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

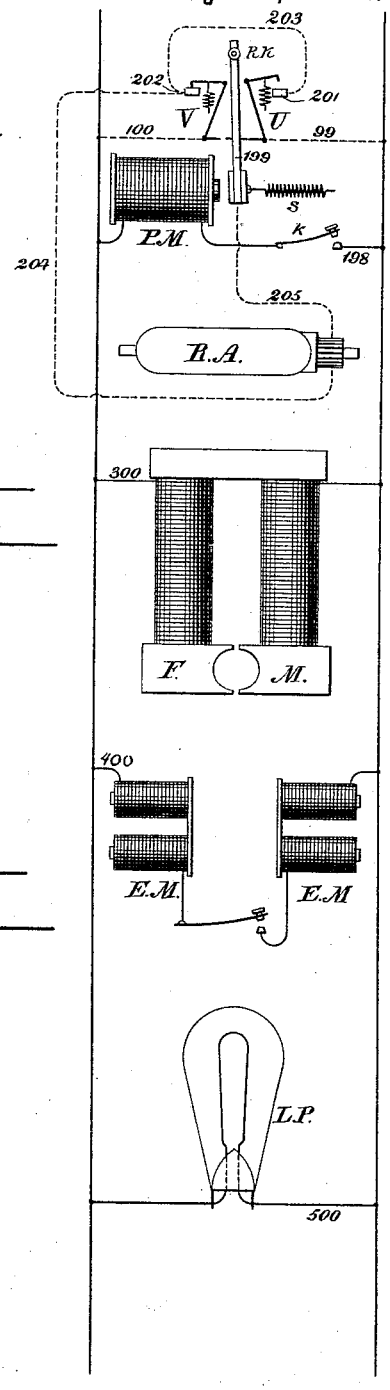


Fig. 2.

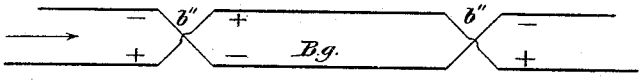
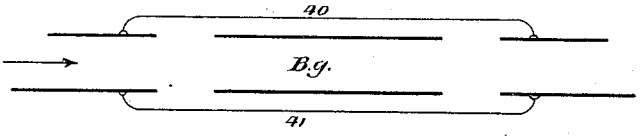


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 475,494, dated May 24, 1892.

Original application filed June 3, 1880, Serial No. 11,243. Divided and application filed May 20, 1882, Serial No. 61,955. Again divided and this application filed June 9, 1891. Serial No. 395,704. (No model.) Patented in England September 25, 1880, No. 3,894; in Canada March 31, 1881, No. 12,568; in India May 3, 1881, No. 341; in Victoria May 12, 1881, No. 3,012; in France May 27, 1881, No. 141,752; in New South Wales June 25, 1881, No. 948; in Queensland June 30, 1881, No. 21,299, and in New Zealand August 2, 1881, No. 542.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Electro-Magnetic Railway System, (for which I have obtained Letters Patent in Great Britain, No. 3,894, dated September 25, 1880; in Canada, No. 12,568, dated March 31, 1881; in India, No. 341, dated May 3, 1881; in Victoria, No. 3,012, dated May 12, 1881; in France, No. 141,752, dated May 27, 1881; in New South Wales, No. 948, dated June 25, 1881; in Queensland, No. 21/299, dated June 30, 1881, and in New Zealand, No. 542, dated August 2, 1881;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This specification is a division of my application, Serial No. 61,955, filed May 20, 1882, which was a division of my application, Serial No. 11,243, filed June 3, 1880.

The object of this invention is to furnish an economical system of electro-magnetic railways or tramways which, while useful in any locality, shall be particularly adapted to regions where the traffic is too light for ordinary steam-railways or where the main bulk of the traffic is limited to certain seasons or where the difficulties or expense of grading render ordinary steam-roads impracticable.

To this end the invention consists in a complete electro-magnetic railway system embracing the generation, distribution, and utilization of electric currents as a motive power and in the novel devices and combination of devices therefor, as more particularly described and claimed.

In carrying my invention into effect the rails of the track are electrically connected, so that each line of rails forms a part of the circuit.

For the traveling motor or locomotive an electro-magnetic engine is mounted upon a suitable frame supported upon the axles of the driving and other wheels. In order that the circuit from one line of rails to the other be not directly through the wheels and axles, but be through the motor, each car is, so to speak, electrically cut in two by the interposition of insulating material somewhere in its structure, the poles of the motor being connected one to each division. A preferable method is to form the hub and flange of a wheel of separate metallic parts, uniting them by bolting each to a wooden web which insulates the two, whereby the body of the car and the axles are insulated from the track. Contact-springs bear against the flanges, or preferably against hubs secured thereto by cross-bars or spiders whose outer ends are bolted to the flanges. The contacts are connected to the brushes of the motor, one to each, respectively, through the reversing-key and contacts hereinafter spoken of.

In the accompanying drawings I show more in detail how this invention may be carried into effect. It is to be remembered, however, that these details may be varied or equivalents used, and that therefore I do not limit myself generally in such cases to the precise details therein illustrated.

Figure 1 is a perspective of an engine-car in operative relation with respect to the source of electricity. Fig. 2 is a diagram showing an arrangement of the conductors to produce an automatic reversal of the motor on the car. Fig. 3 is a diagram showing an arrangement of conductors by which the current supplied to the motor on the car is varied without reversal. Fig. 4 is a diagram showing the connection of electrical devices on the car in multiple arc.

B is any suitable stationary dynamo-electric machine driven by any suitable source of power. From the generator B connection through conductors 1 and 2 is made to the rails of the main track M T, respectively.

The current is utilized as a motive agent by an electro-magnetic engine M E, constructed as shown in the drawings, in which F is any suitable frame-work suspended from the main driving-axle and placed upon the other axle.

The wheels used under the engine-car and all other cars are constructed as shown. The flange F′ and hub M are made separately and connected by a wooden web O, to which they

are bolted, the wheel then consisting of a metallic hub, a metallic flange, and an intervening wooden or insulating web. By this means the axle and body of the car are insulated from the flanges and track and the current cannot pass therethrough from one rail to the other.

On the engine-car a spider or frame N is secured to the flange F′, so as to be in electrical contact therewith, but not touching or forming contact with the hub M. Upon the center of N is a boss or spindle *n*, on which bears a contact-brush held by an arm P.

On the main axle *g* is a friction wheel or pulley G. On the armature-shaft is a friction-pulley *e*. These wheels are not directly in contact.

i is a friction-pulley in a movable frame *f*, pivoted at *h*. By depressing *f* wheels *e*, *i*, and G form a connected train and the rotation of the armature is communicated to the axle *g*. Current passes from the track M T *via* F′ N *n* P through the motor and armature to the opposite line of rails M T.

E M is a magnet fixed to the frame for increasing the traction of the car upon the track. This magnet is in a multiple-arc branch with a key *k′* for controlling the current in said branch, and there is a lamp L P in another similar branch. The field-magnets of the motor F M are in a branch and the motor-armature R A is in a separate branch, with a key or circuit-changer R K for reversing the direction of current flowing in said armature. This key is composed of two elbow-levers U and V, pivoted at the angle thereof. Each is controlled by a retracting-spring, as shown. The ends of the shorter arms take against fixed contacts 201 and 202, respectively, where the retracting-springs tend to hold them. There is a lever 199 located between U and V. It is pivoted at the upper end, as shown. This lever carries contact-points registering and forming contact with contacts on the longer ends of these elbow-levers. Elbow-lever U is connected to branch 99, and elbow-lever V is connected to branch 100. Fixed contacts 201 and 202 are electrically united by wire 203, and both are connected to the terminal of the armature by branch 204. The lever 199 is connected to the other terminal of the armature by wire 205. Lever 199 may be moved to and fro by the electro-magnetic device P M, which is a polarized magnet in branch circuit 198. The polarized armature on bar 199 is controlled by retracting-spring *s*. The direction of current normally flowing in magnet P M acts in the same sense with retracting-spring *s* to hold bar 199 in the position shown; but whenever the direction of the current flowing in the branch 198 is reversed the magnet P M acts against spring *s* and overcomes it and the position of the reversing-switch is changed, whereby the direction of current flowing in the armature-coils is reversed.

The several branches 99, 198, 300, 400, and 500 are all parallel and terminate in the contact branches P on opposite sides of the car.

In crossing a bridge or in passing over a section of the road, which for any reason should be traversed slowly and carefully, it is very desirable to slow down the speed at a predetermined point and to do this automatically, for in this way the inattention and carelessness of the driver can best be guarded against. To accomplish this I so arrange the conductors connecting the source of electricity with the motor that the section adjacent to the point where reduced speed is desirable shall present a variation in electrical condition from that of the remainder of the circuit, and I so arrange the conductors that a variation in current shall be transferred to the motors which shall operate to retard the motion or to brake the vehicle. This may be done by reversing the direction of the current to reverse the direction of rotation and so brake the vehicle; or if a less abrupt retardation is desired I modify the strength of current or cut it off entirely, or I combine both of these devices to produce a more perfect result.

Figs. 2 and 3 illustrate the arrangement described. In Fig. 2 a section of a mechanically continuous and practically uniform conductor forming a track for a rotating collecting device is separated from the adjacent portion and an electrical cross-connection is established, to the end that the separated section normally positive shall be negative and the section normally negative shall be positive. The section B*g* is a section of the road and conductor at a bridge. The mechanical continuity of the conductor is interrupted, as at *b″ b″*, and an electrical connection is permanently established between each end of the divided conductor on one side and the ends of the separated section upon the other side, the result being that the separated section formerly positive is now negative, and vice versa. In Fig. 3 the separated section B*g* is left out of circuit entirely, the electrical continuity being established around said section by wires 40 and 41. In other words, the section is "cut out," electrically speaking, although both in Figs. 2 and 3 the mechanical continuity is practically uninterrupted.

When the electrically-propelled car shown in Fig. 1 arrives at the bridge B*g*, (shown in Figs. 2 and 3,) the current flowing in the circuit on the car composed of the various parallel branches shown in Fig. 4 is broken or its direction is reversed. Let us consider the case of the arrangement shown in Fig. 2. The car shown in Fig. 1 is moving in the direction of the arrow, Fig. 2. Before arriving at the section B*g* current flows through the car-circuit from + to − and the motor-armature revolves in a direction to propel the car forward. After entering upon the section B*g* the direction of the flow is reversed with respect to the car-circuits. As this reversal

would occur in the branch 300 containing the field-coils and also in the branch 99 including the coils of the armature, no immediate effect upon the movement of the car is apparent, but the current is also reversed in the branch 198 containing the coils of the polarized electro-magnet P M, and this operates the lever 199, which reverses the direction of current in the rotating armature R A. The motor now has a tendency to reverse its rotation and operates to brake the vehicle, which immediately slows down; but by the time the reversal of rotation has become effective to overcome the momentum of the car and begin a reverse movement the end of the section B*g* has been reached and normal conditions are restored, the motor resuming its operation to propel the car forward. This is of course due to the restoration of the normal direction of current in branches 300, 99, and 198, the current in the last-named branch operating to restore the reversing-key R K to the position shown in the drawings.

In the arrangement of the conductors shown in Fig. 3 current is withdrawn from the car-circuit entirely in passing the section B*g*, and the movement of the car is simply retarded without the employment of the braking operation due to the reversal of rotation of the motor.

I do not abandon or dedicate to the public any patentable matter herein described or shown but not claimed, as such forms the subject-matter of my applications Serial No. 11,243, filed June 3, 1880, and Serial No. 61,955, filed May 20, 1882, or of one of the divisions thereof, serially numbered 395,700, 395,701, 395,702, 395,703, or 395,705, filed June 9, 1891.

What I claim, and desire to secure by Letters Patent, is—

1. The combination, in an electric-railway system, of a stationary source of electricity, a moving vehicle, an electric motor on the vehicle, mechanical connections between the rotating part of the motor and a wheel or axle of the vehicle, a main line of conductors extending from the source of electricity to the vehicle, having a section thereof isolated from adjacent sections in the same line, and traveling contacts connecting the circuit on the vehicle with said main line or circuit or a section thereof, whereby the variation due to the described arrangement of the main line is automatically imparted to the motor to produce a corresponding variation in the movement of the vehicle, substantially as described.

2. The combination, in an electric-railway system, of a stationary source of electricity, a moving vehicle, an electric motor on the vehicle, a mechanical connection between the driving part of the motor and the driven part of the vehicle, conductors extending from the source of electricity to the motor, one or more sections of said conductors being arranged to present a predetermined variation in the electrical condition thereof, substantially as described, and traveling contacts for connecting the motor-circuit on the car with said conductors, whereby the movement of the vehicle is made to correspond with the condition of the track or rails.

3. In an electric railway, the combination, with a section of main conductors, of a short section thereof cut out of the main section and connected reversely thereto by conductors arranged to reverse the direction of the current in such short section, substantially as set forth.

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