(No Model.) 3 Sheets—Sheet 1.

M. W. DEWEY.

ELECTRIC RAILWAY.

No. 452,099. Patented May 12, 1891.

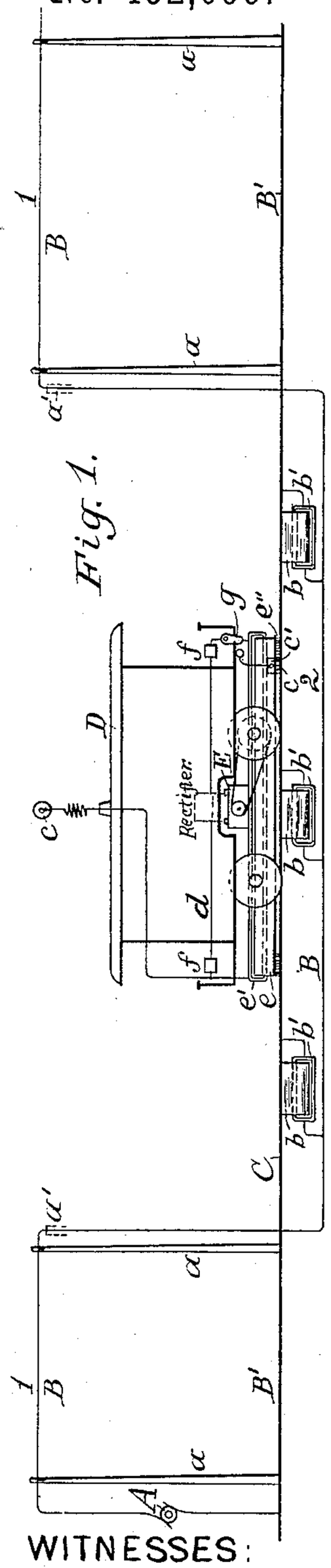

Fig. 1.

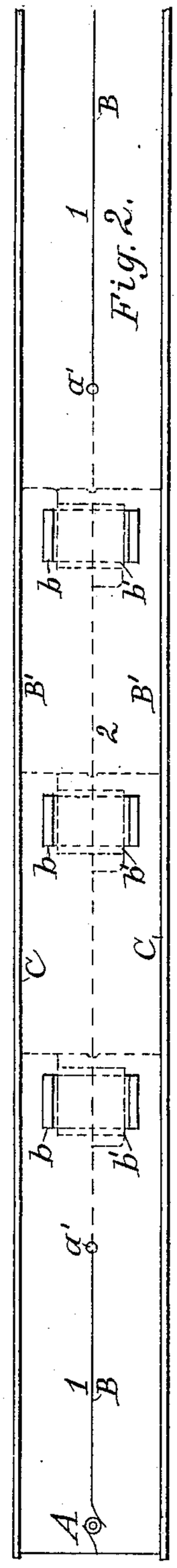

Fig. 2.

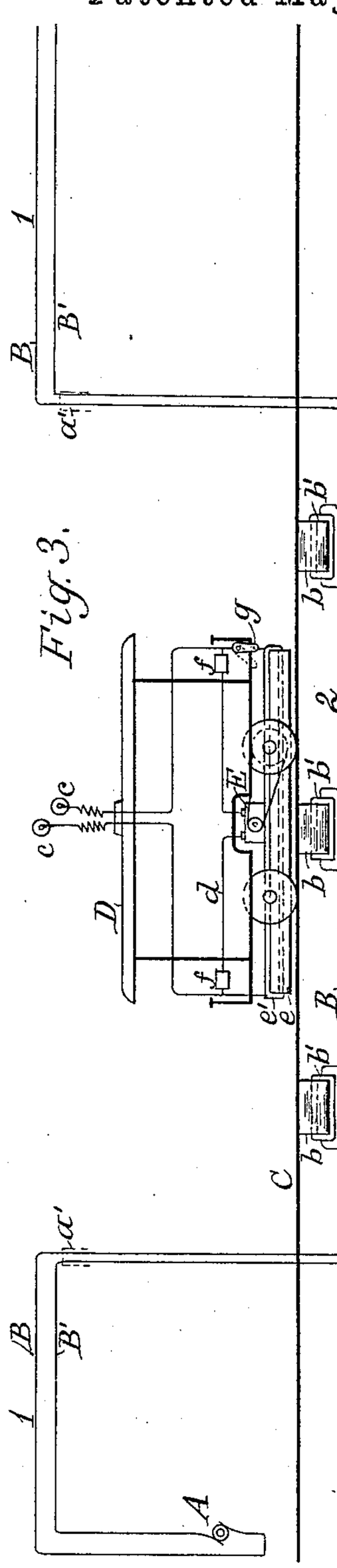

Fig. 3.

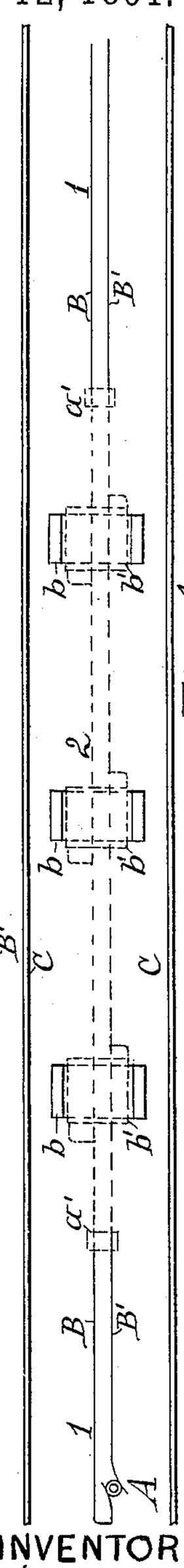

Fig. 4.

WITNESSES:

J. J. Laass.

H. M. Seamans

INVENTOR:

Mark W. Dewey

By Duell, Laass & Duell

his ATTORNEYS.

(No Model.) 3 Sheets—Sheet 2.

M. W. DEWEY.

ELECTRIC RAILWAY.

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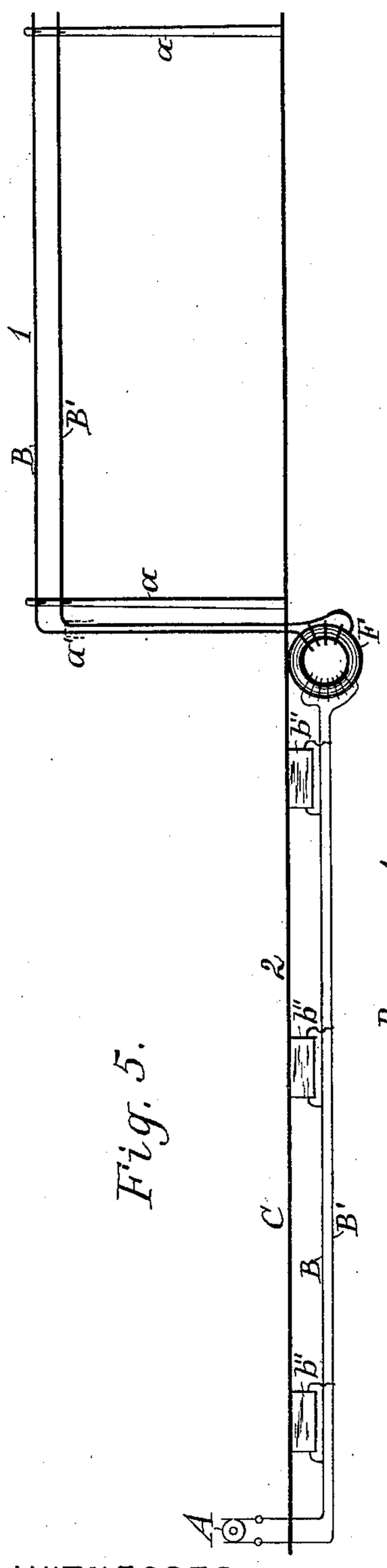

Fig. 5.

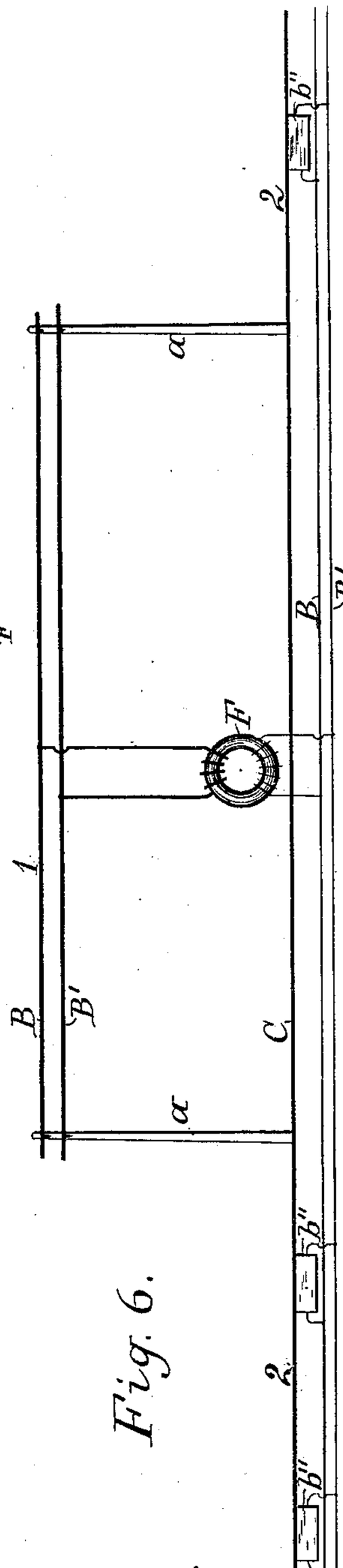

Fig. 6.

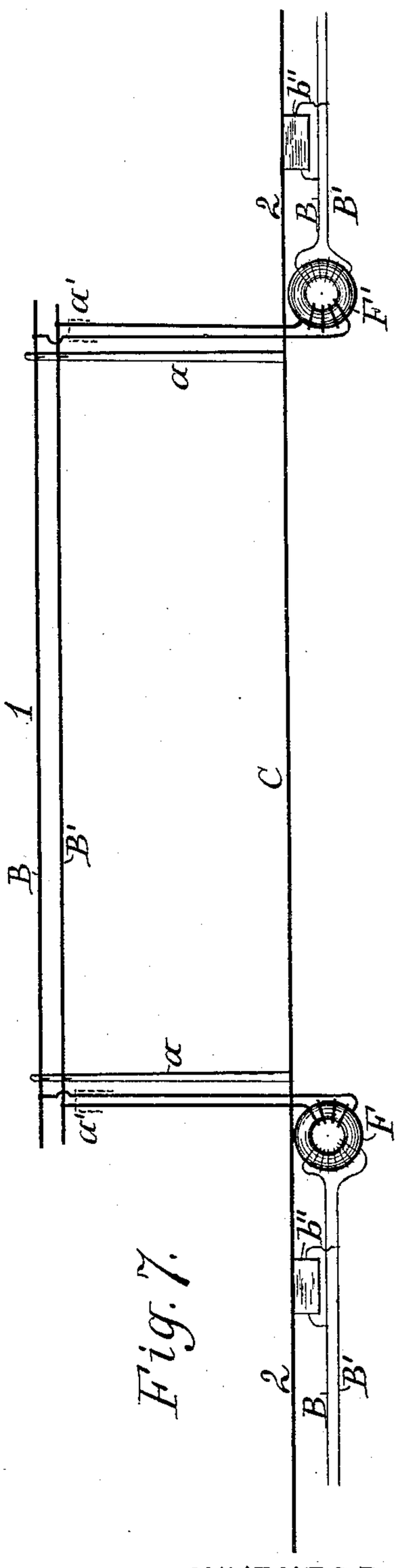

Fig. 7.

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(No Model.) 3 Sheets—Sheet 3

M. W. DEWEY.

ELECTRIC RAILWAY.

No. 452,099. Patented May 12, 1891.

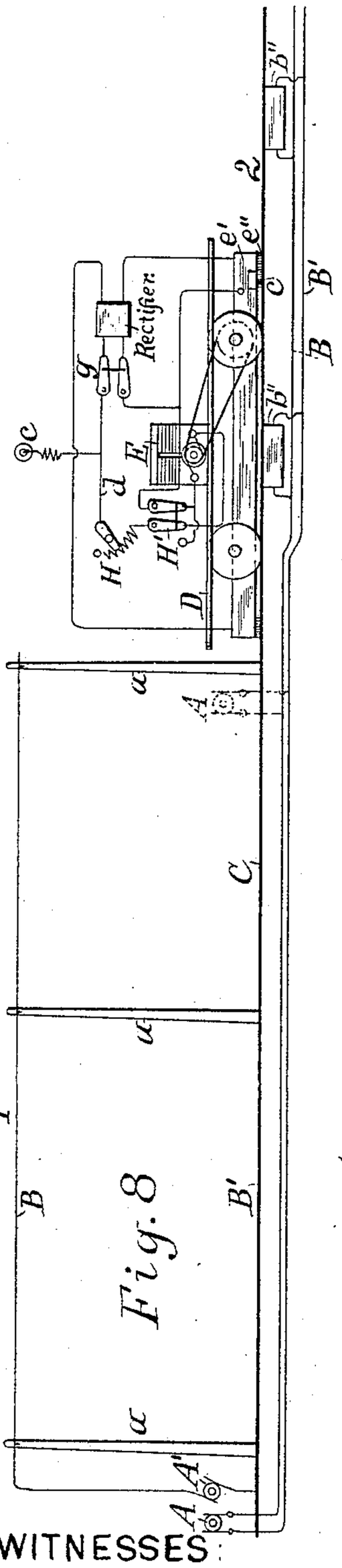

Fig. 8.

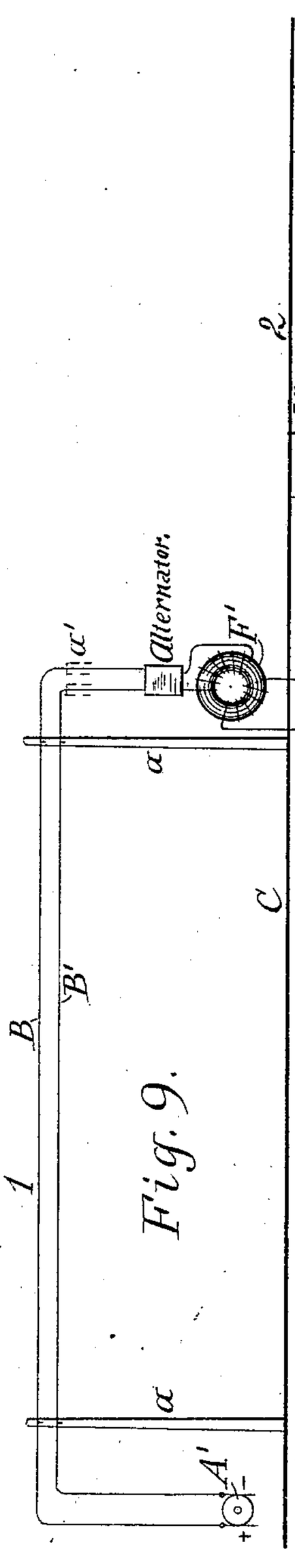

Fig. 9.

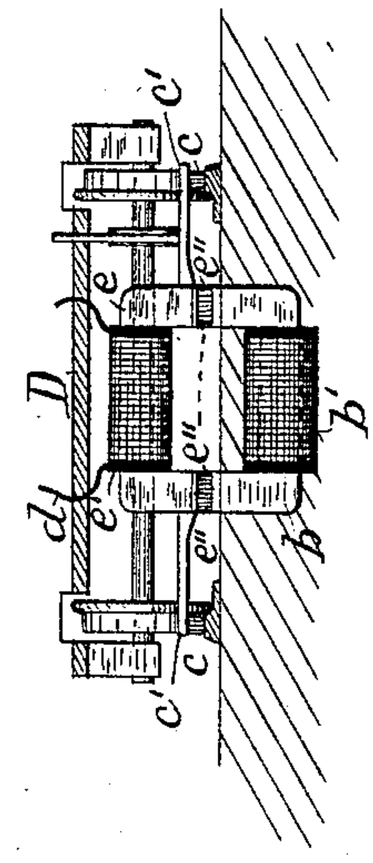

Fig. 10.

WITNESSES:

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UNITED STATES PATENT OFFICE.

MARK W. DEWEY, OF SYRACUSE, NEW YORK, ASSIGNOR TO THE DEWEY CORPORATION, OF SAME PLACE.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 452,099, dated May 12, 1891.

Application filed December 20, 1890. Serial No. 375,391. (No model.)

To all whom it may concern:

Be it known that I, MARK W. DEWEY, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Electric Railways, (Case No. 81,) of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to electric railways; and the object is to combine an induction system the same or similar to that shown and described in a prior application of mine, Serial No. 315,457, filed June 25, 1889, with any well known conduction system.

The purpose of my invention is to provide a system that as a whole will be less expensive than a system operated entirely by the induction plan. The devices necessary for the construction of an efficient induction system make such system much more expensive than an ordinary conduction system. By combining the two systems in one a more simple construction is derived, and in many cases all the advantages are obtained which would be gained by an entire induction system. For electric railways extending through city and suburban places or the country this system is particularly adapted, as the underground induction system may be employed in the city or through the streets thereof on which there is considerable travel, while the overhead conduction system, or a system having exposed line conductors, is used in the suburbs or in the country. Electric railways often extend through and between two cities and a distance of several miles through the country where there is but little travel, and where the overhead conduction system is not objectionable. In such cases the induction system is employed for the end portions of the road that are in the cities, while the intermediate portion in the country is equipped with the overhead conduction system. Exposed line conductors for railways in cities are objectionable for many reasons, and in some cities they are not allowed to be suspended because thereof. As the induction system is free from these objections and has most of the advantages of the conduction system, it is very essential that the two systems be combined to produce a system that is both efficient and economical. The car or cars for this railway are equipped to receive current for the propelling-motors from either and both systems and without interruption, as hereinafter described.

To this end my invention consists, broadly, in an electric railway having a portion thereof equipped with a conduction system and another portion equipped with an induction system.

My invention consists, further, in the combination, in an electric railway, of a track, an exposed line working-conductor extending along a portion of the track, an insulated line working-conductor extending along another portion of the track, a source of alternating currents of electricity for the insulated line conductor, a car to move upon said track, a circuit on the car, a terminal for said circuit to make contact with the exposed line conductor, a circuit on the car adapted to be completed thereon, a portion of the latter circuit arranged in inductional relation to the insulated line conductor, and a motor on the car in both of the circuits thereon and arranged to move the car; and my invention consists, also, in certain other combinations of apparatus hereinafter described, and specifically set forth in the claims.

In the accompanying drawings, Figure 1 is a side elevation, partly in section, of an electric railway and motor car embodying my invention. Fig. 2 is a plan view of the same. Figs. 3 and 4 are modifications of Figs. 1 and 2. Figs. 5, 6, 7, 8, and 9 are modifications of side elevations of my electric-railway system, and Fig. 10 is an end elevation of the railway-car equipped with my induction system, and shows, also, a cross-section of the railway.

Referring specifically to the drawings, A in the figures represents a source of irregular or alternating currents. B and B′ are the line conductors connected therewith and extending along the railway or track C.

a a, &c., are poles or supports for the suspended exposed line conductor or conductors 1, and 2 indicates the underground insulated line conductor or conductors of the induction portion of the railway.

b b b are U-shaped iron cores placed at in-

tervals along the induction portion of the railway and preferably equal distances apart. Said cores are embedded in the roadway and arranged at right angles to the rails thereon, but with their poles extending to, in proximity to, or above the surface of, the road-bed, preferably the latter. The poles of said cores are located on each side of the center of the road-bed, but preferably between the rails of the track. I do not limit myself to any particular distance between two of said cores, but they may be placed apart about the length of a car with good results. *b' b' b'* are coils wound upon the said cores. The coils are shown connected in parallel with the line-conductors, as this is preferred, but it will be obvious that in some cases they may be connected in series. The reference-figure 1 also represents the portion or portions of the railway equipped with the conduction system, and the reference-figure 2 the portion or portions of the railway equipped with the induction system.

D is the vehicle or car to travel on the railway.

d is the vehicle-conductor or the electric circuit on the vehicle, and *c c* are terminals of the conductor to move in contact with the exposed line conductors, and which may be of any suitable construction.

e is an elongated iron core carried on the vehicle, and is similar to the cores *b b*, but is inverted, and *e'* is a coil wound on said core and connected in circuit with the vehicle-conductor.

E is an electric motor in the vehicle-conductor, and *f f* are current-regulators therefor, also in the circuit.

A current-rectifier is indicated in dotted lines on the car in Fig. 1, and is to be employed when the motor E is a direct-current motor. When an alternating-current motor is employed, the rectifier is dispensed with.

The ends of the insulation on the line conductor or conductors of portion 2 of the railway are indicated by dotted lines at *a' a'*.

In Figs. 1 and 2 of the drawings the end portions of the railway are shown equipped with the conduction system or overhead exposed line working-conductors, while the intermediate or central portion is equipped with the underground induction system. The cores for the latter system are preferably laminated or divided to prevent cross-currents. The ends or poles of the cores may be separated by an air-space, or they may be connected by iron rollers or brushes *e'' e''*, fixed to the ends of the vehicle-core to form a closed magnetic circuit. In the same figures but one of the line conductors B is suspended and the other B' is formed by the rails of the track. One terminal or contact *c* of the vehicle-conductor is mounted on the top of the car D, while the other contact *c* is formed by the wheels of the car, or is mounted upon arms *c'* fixed to the core and extending outward toward and above the rails of the track, as shown in Fig. 10 of the drawings. In Fig. 1 is also shown a switch *g* for alternately closing and opening the circuit containing the coils *e'* and the conductor connected to the movable contacts *c c*. The said switch may be moved to open both circuits by moving its free end to the right from the position in which it is shown in the figure, but when moved to the left it will close the conductor connected to the contacts *c c* and open the circuit of the coil *e'* or cut the same out of circuit. In the position in which it is shown the coil or complete circuit on the vehicle is closed.

The coil or complete circuit is to be closed when the car is on the portion of the railway equipped with the induction system, and said circuit is to be opened and the conductor connected with the contacts *c c* closed when the car is upon the portion of the road equipped with the conduction system or exposed line conductors. The switch should be operated when the car is moving from one portion to a differently equipped portion of the railway.

In Figs. 3 and 4 both line working-conductors are suspended at portions 1 1 of the road and the rails of the track are not used for the return-conductor. In this case both of the contacts are mounted on the top of the car, as the lines are overhead, and the switch *g* simply cuts out or in the coil *e'* when it is moved. The other circuit of the motor is opened and closed automatically by the car when it moves from one portion of the railway to another. The current-rectifier can be used with this plan also when desired—that is, when a direct-current motor is employed to propel the vehicle. In other respects the said figures are the same as or similar to Figs. 1 and 2.

Fig. 5 represents a railway divided into two portions only, the portion at the end where the source of electricity is located being equipped with the induction system, and the other end portion with the conduction system. The cores and coils in the road-bed are simply indicated in this figure, and also in some other figures hereinafter described, by boxes *b''*, which inclose said cores and coils.

In Fig. 5 an inductional current-transformer F is shown connected between the different portions or systems of the railway for the purpose of changing or reducing the tension of the current for the exposed line conductors. One of the coils of the said transformer is connected in circuit with the alternating-current dynamo A, and the other coil of the transformer is in circuit with the exposed line conductors. The exposed line conductors in this case may be of greater cross-section than the insulated conductors, if desired, and the convolutions of the former on the core of the transformer may be less in number than the convolutions of the latter or primary coil.

In Fig. 6 the intermediate or central portion of the railway is equipped with exposed line conductors. The insulated conductors

extend underground between the portions 2 2. The transformer F is located and feeds the overhead conductors about midway between the portions 2 2. A plurality of transformers may be used and placed at intervals along the line, if required.

Fig. 7 is similar in most respects to Fig. 6; but the primary circuit does not extend bebetween the portions 2 2 of the railway, as in Fig. 6. A transformer F, the same as that shown in Fig. 5, is employed between the portion 1 on the left and one end of the conduction system, and a similar transformer F′ reversed is located between the other end of the conduction system and the second induction portion of the railway. With this arrangement a great deal is saved in line conductors, especially when such central portion is very long. A reduced tension is maintained in the exposed lines by the transformer F, and an increased volume also, if desired, and then by the transformer F′ the transformed current or a portion thereof in the exposed lines is reconverted into a current of higher tension and less volume, if desired, for the second induction portion of the railway.

In Fig. 8 the railway is divided into two parts or portions, the portion on the left or near the generating-station being equipped with the conduction system and the portion on the right with the induction system. In this case the exposed line conductors, one of which is shown suspended and the other being formed by the rails of the track, are connected with a source of direct continuous current, as a direct-current dynamo A′ located at the generating-station, where the source of alternating currents A for the induction system is located. In order to save line conductors, the dynamo A may be located between the two systems at a separate generating-station, as shown in dotted lines in the figure, and, if desired, both dynamos may be located at this point, thus dispensing with the other generating-station. The car in Fig. 8 is shown equipped with a direct continuous-current motor, a rectifier, and current-regulators H and H′ for the motor. The switch *g* is a double-pole switch in this case, and is located in the vehicle-circuit so as to cut out the rectifier with the coil *e′*, as the rectifier will not, of course, be required when the said coil is not in use, or when the car is on the portion of the railway equipped with the conduction system.

In Fig. 9 a direct continuous-current dynamo is shown as employed to generate the currents for both systems. The said dynamo A′ is shown located at one end of the railway, but it may be located at the junction of the two portions or systems, if preferred. An inductional transformer F′, the same as that shown in Fig. 7, is shown between or connecting the two systems for the purpose of increasing the tension of the current in the insulated leads, and a suitable current-alternator is indicated in the primary circuit near the transformer to rapidly alternate the current for the transformer and for the induction portion 2 of the railway.

I do not limit myself to the details of construction, as they may be modified in various ways without departing from my invention.

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

1. In an electric railway, a supply-conductor extending along the railway, a car to move along said railway, an electric motor to propel the car, an electric conductor on the car connected to the motor, an electric connection to conduct the current between the supply-conductor and the car-conductor, and suitable means on the car whereby the current for the motor may be induced by the current in the supply-conductor.

2. In an electric railway, the combination of a track, an exposed line working-conductor extending along a portion of the track, an insulated line working-conductor extending along another portion of the track, a source of alternating currents of electricity for the insulated line conductor, a car to move upon said track, a circuit on the car, a terminal for said circuit to make contact with the exposed line conductor, a second circuit on the car adapted to be completed thereon, a portion of the latter circuit arranged in inductional relation to the insulated line conductor, and a motor on the car in both of the circuits thereon and arranged to move the car.

3. In an electric railway, the combination of a track, an exposed line working-conductor extending along a portion of the track, an insulated line conductor extending along another portion of the track, a source of irregular or alternating currents for both conductors, a car to move on said track, a circuit on the car, having a terminal to move in contact with the exposed conductor, means to form a complete circuit on the car, a portion of the complete circuit in inductional relation to the insulated line conductor, and a motor on the car in the circuit thereon and arranged to propel the car.

4. In an electric railway, a supply-conductor extending along the railway, a car to move along said railway, an electric motor to propel the car, an electric conductor on the car connected to the motor, an electric connection to conduct the current between the supply-conductor and the car-conductor, and suitable means on the car whereby the current for the motor may be derived from the supply-conductor by induction.

5. In an electric railway, a supply-conductor extending along the railway, having one or more portions of its length exposed and one or more portions insulated, a car to move along said railway, an electric motor to propel the car, an electric conductor on the car connected to the motor, an electric connection to conduct the current between the exposed portion or portions of the supply-conductor and the car-conductor, and suitable means

whereby the current for the motor may be derived from the insulated portion or portions of the supply-conductor by induction.

6. In an electric railway, a supply-conductor extending along the railway, having one or more portions of its length exposed and suspended above the ground and one or more portions insulated and beneath the surface of the ground, a car to move along said railway, an electric motor to propel the car, an electric conductor on the car connected to the motor, an electric connection to conduct the current between the exposed portion or portions of the supply-conductor and the car-conductor, and suitable means whereby the current for the motor may be derived from the insulated portion or portions of the supply-conductor by induction.

7. In an electric railway having a conduction system for one portion and an induction system for another portion, a source of high-tension current for the induction system, and a transformer to reduce the tension of a portion of the said current to supply the conduction system.

8. The combination of a car or vehicle movable along a given path, a series of stationary magnetic cores placed at intervals along a portion of said path, coils surrounding said cores and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, and an electro-magnetic motor on the car and for propelling the same and connected in circuit with the secondary conductor.

9. The combination of a car or vehicle movable along a given path, a series of stationary magnetic cores placed at intervals along a portion of said path, coils surrounding said cores and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path and deriving current from the same source, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, and an electro-magnetic motor on the car and for propelling the same and connected in circuit with the secondary conductor.

10. The combination of a car or vehicle movable along a given path, a stationary magnetic core extending along a portion of the path, a conductor to magnetize said core and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, and an electro-magnetic motor on the car and for propelling the same and connected in circuit with the secondary conductor.

11. The combination of a car or vehicle movable along a given path, a stationary magnetic core extending along a portion of the path, a conductor to magnetize said core and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path, a current-transformer between the said conductor connected with the source and the exposed line conductor, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, and an electro-magnetic motor on the car and for propelling the same and connected in circuit with the secondary conductor.

12. The combination of a car or vehicle movable along a given path, a stationary magnetic core extending along a portion of the path, a conductor to magnetize said core and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path, an inductional transformer having one of its coils in circuit with the conductor connected with the source and the other coil in circuit with the exposed line conductor, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, and an electro-magnetic motor on the car and for propelling the same and connected in circuit with the secondary conductor.

13. The combination of a car or vehicle movable along a given path, a series of stationary magnetic cores placed at intervals along a portion of said path, coils surrounding said cores and connected with a source of irregular or alternating currents, an exposed line working-conductor extending along another portion of the said path, a magnetic core carried by the car in inductional relation to the stationary cores, a secondary conductor wound thereon, a movable contact connected to the secondary conductor to make contact with the exposed line conductor, a current-rectifier in the conductor on the vehicle, and a direct-current motor on the car and for propelling the same and connected in circuit with the secondary conductor.

14. In an electric railway having a conduction system for one portion and an induction system for other portions of the railway, the combination of a source of high-tension current for one of the portions equipped with the

induction system, a transformer to reduce the tension of a portion of the said current to supply the conduction system, and a transformer to increase the tension of a portion of the current of the conduction system to supply another portion of the railway equipped with the induction system.

15. In an electric railway having a conduction system for one portion and an induction system for another portion of the railway, a source of low-tension current for the conduction system, and a current-transformer to increase the tension of a portion of the said current to supply the induction system.

16. In an electric railway having a conduction system for one portion and an induction system for another portion, means for supplying the conduction system with a direct current and the induction system with an alternating current.

17. In an electric railway, a supply-conductor extending along the railway, having one or more portions of its length exposed and one or more portions insulated, means for supplying the exposed portion or portions of the supply-conductor with a current of lower tension than the other portion or portions, a car to move along said railway, an electric motor to propel the car, an electric conductor on the car connected to the motor, an electric connection to conduct the current between the exposed portion or portions of the supply-conductor and the car-conductor, and suitable means whereby the current for the motor may be derived from the insulated portion or portions of the supply-conductor by induction.

In testimony whereof I have hereunto signed my name this 15th day of December, 1890.

MARK W. DEWEY. [L. S.]

Witnesses:
C. H. DUELL,
H. M. SEAMANS.