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No. 776,826. PATENTED DEC. 6, 1904.

O. H. CALDWELL.

ELECTRIC PROPULSION OF CARS OR THE LIKE.

APPLICATION FILED FEB. 15, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

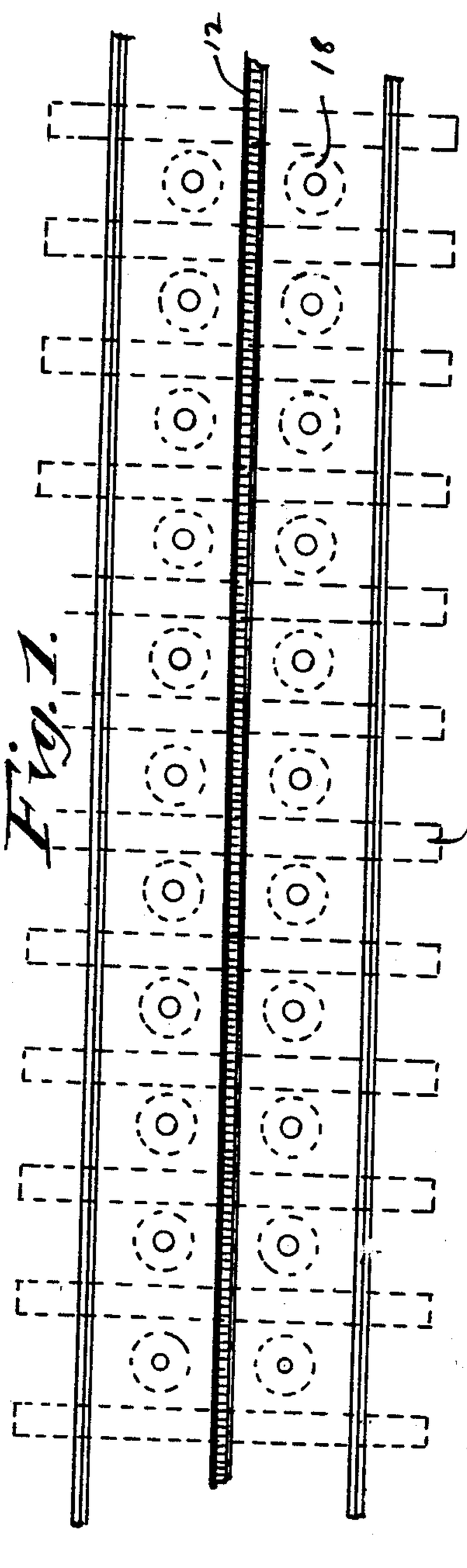

Fig. 1.

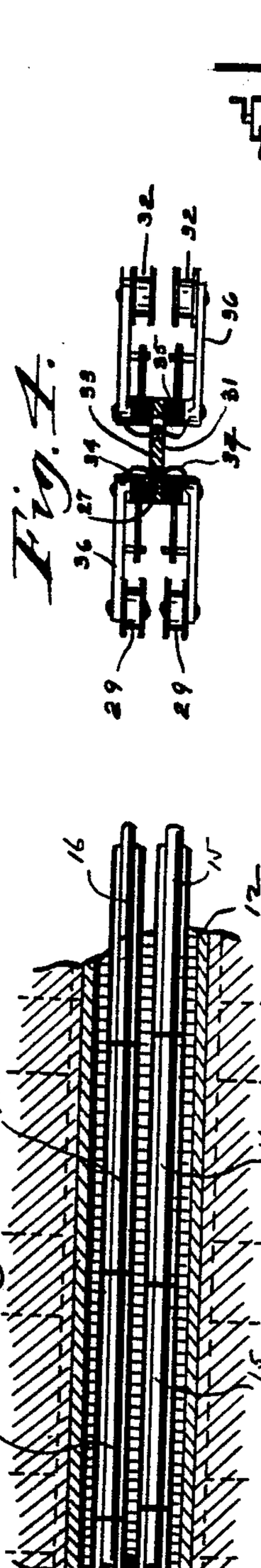

Fig. 4.

Fig. 3.

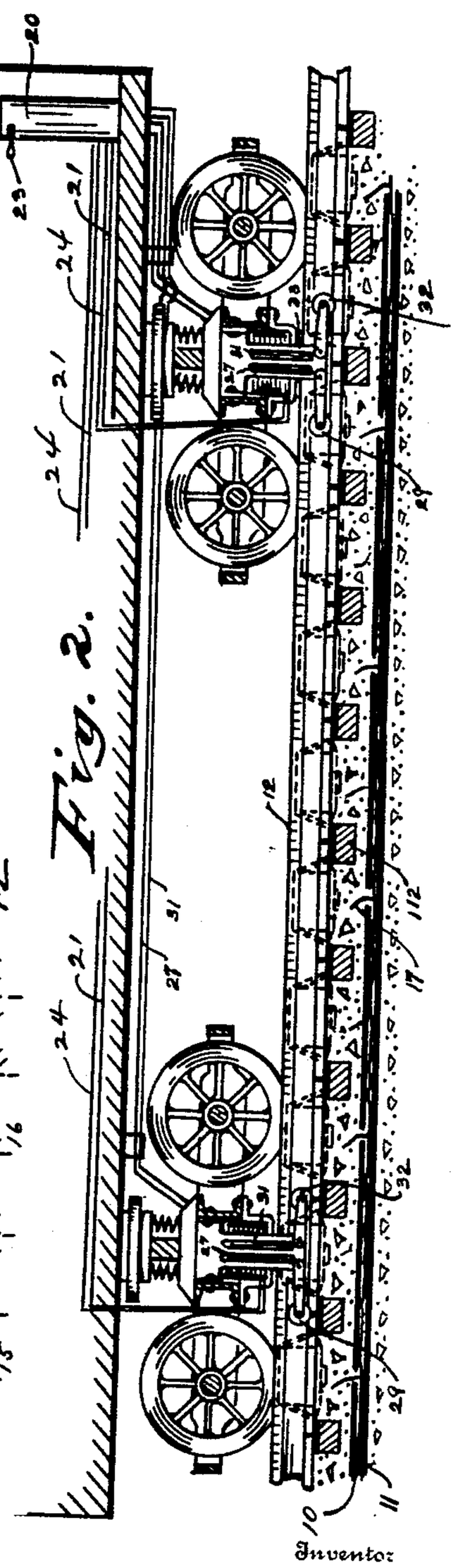

Fig. 2.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 5.

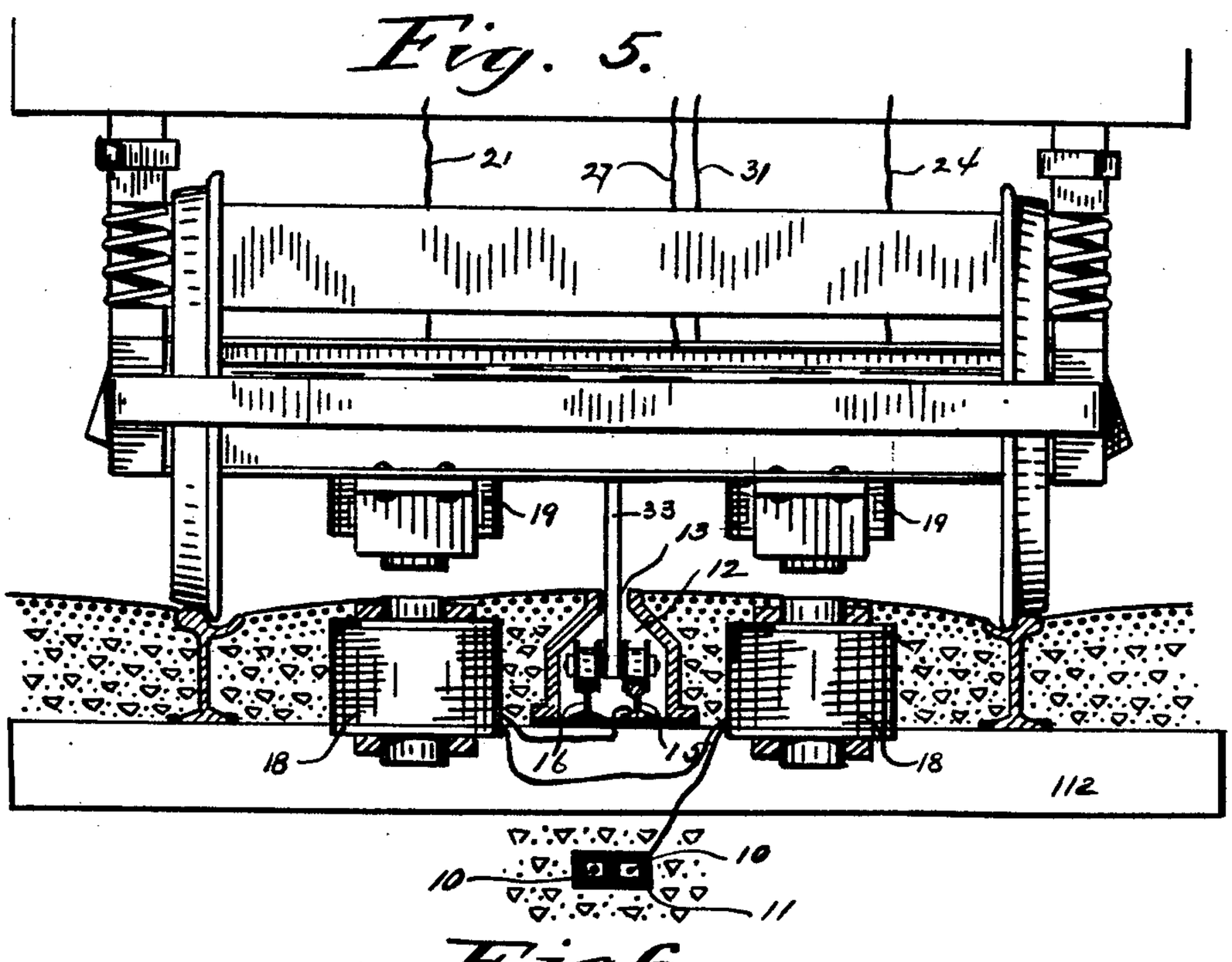
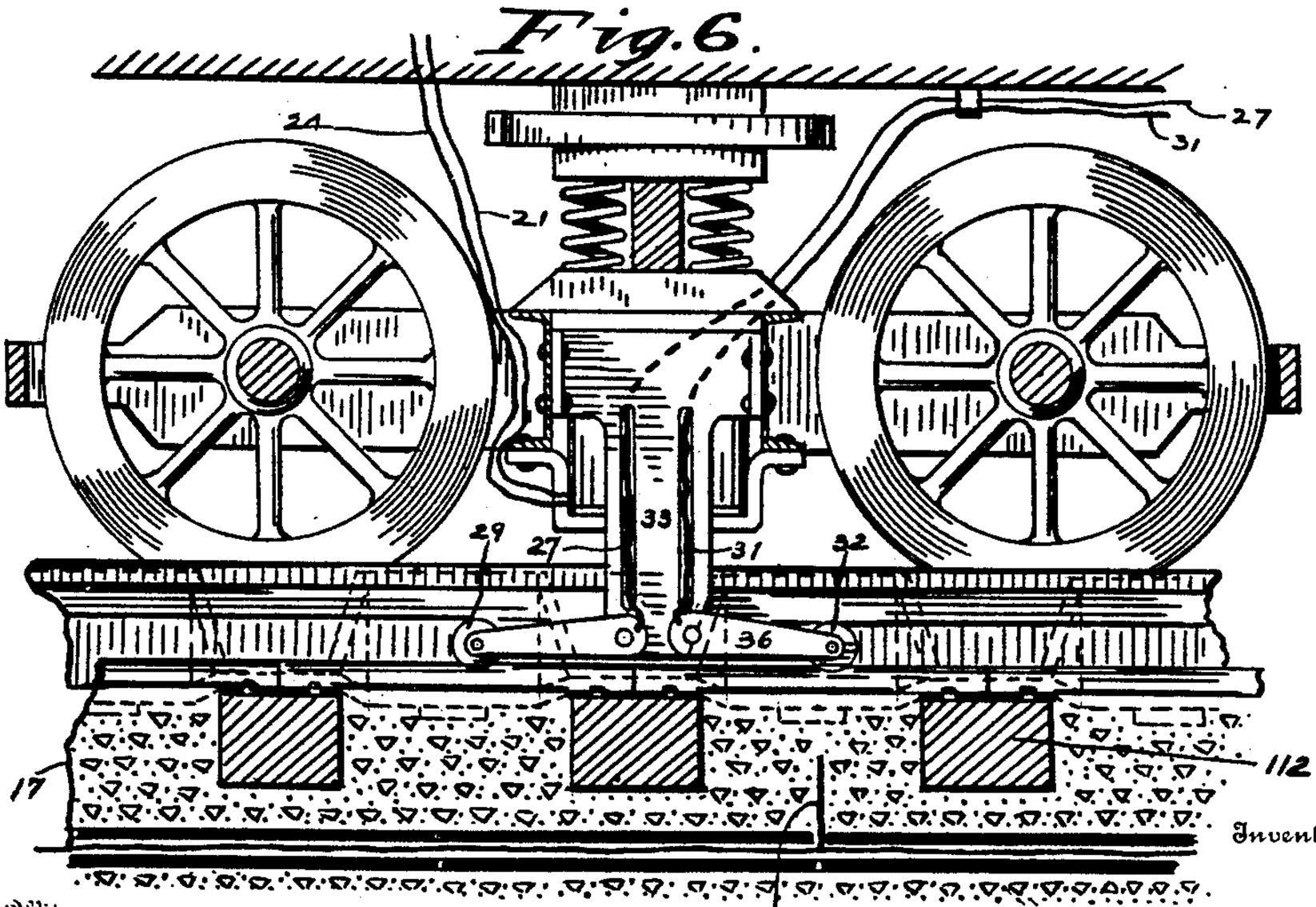


Fig. 6.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 7.

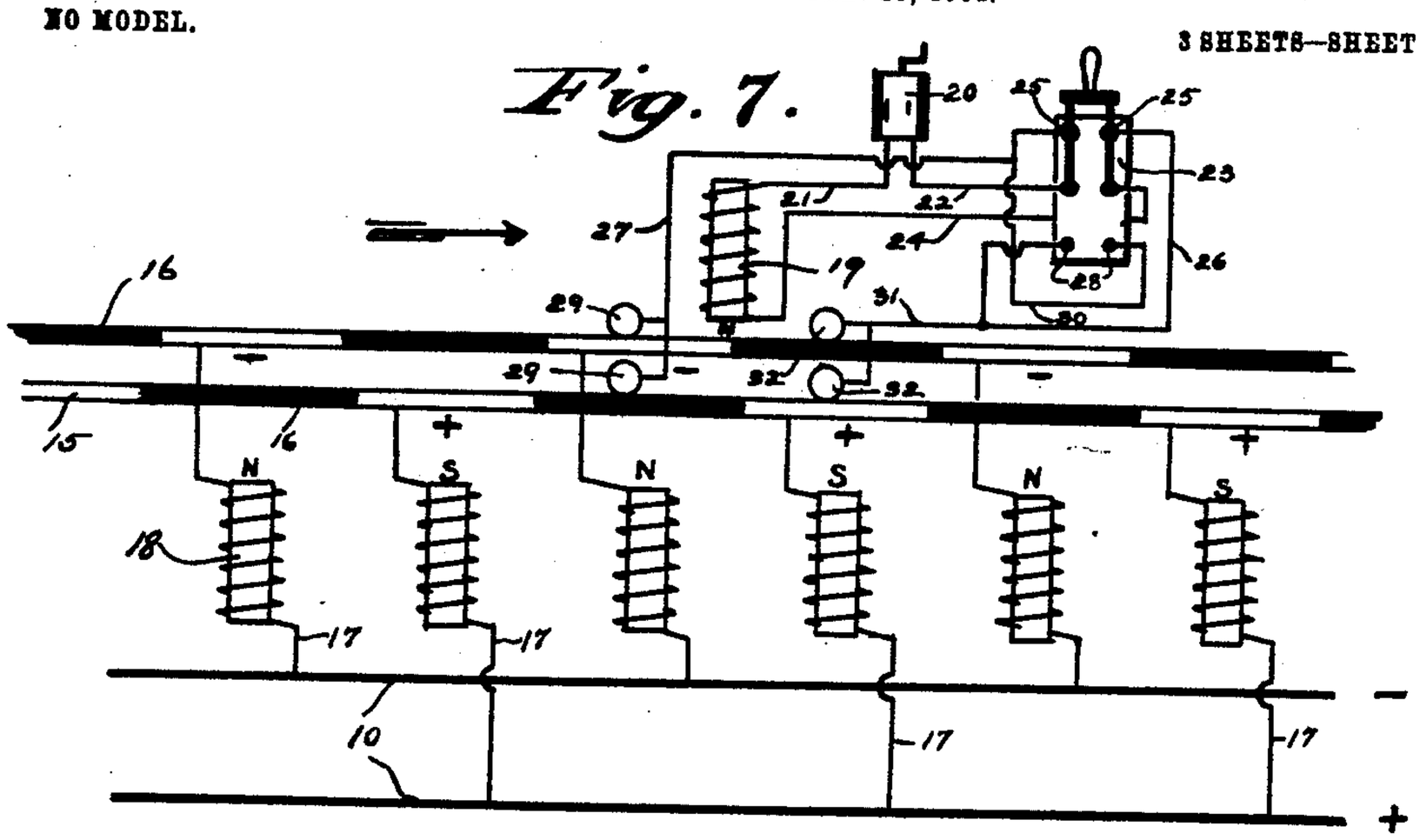
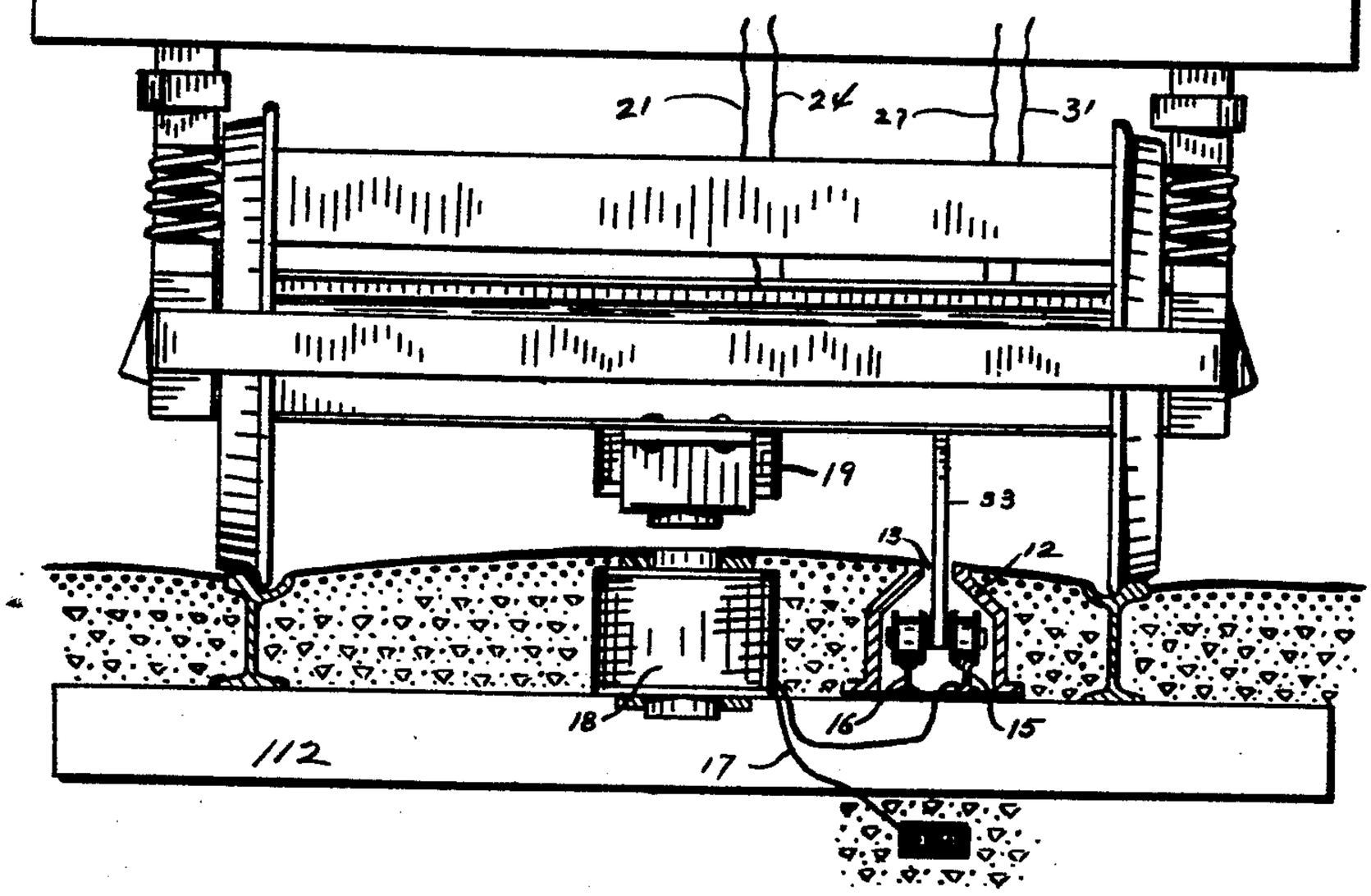


Fig. 8.



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No. 776,826. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

ORESTEZ HAMPTON CALDWELL, OF INDIANAPOLIS, INDIANA.

ELECTRIC PROPULSION OF CARS OR THE LIKE.

SPECIFICATION forming part of Letters Patent No. 776,826, dated December 6, 1904.

Application filed February 15, 1904. Serial No. 193,755. (No model.)

To all whom it may concern:

Be it known that I, ORESTEZ HAMPTON CALDWELL, of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Electric Propulsion of Cars or the Like; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like figures refer to like parts.

This invention relates to improvements in a system for the propulsion of movable bodies, but is more especially designed as an improvement in an electric-railway system; and it has for its object to provide a system of this class wherein the motive power used is that of an electromagnetic field in contradistinction to the use of the ordinary geared motor now commonly employed.

The further object of the present invention is to provide a system of the character mentioned embodying in its construction a simple and efficient arrangement of electromagnets located in the road-bed which are in the nature of field-magnets that coöperate with either a single or a plurality of magnets carried by the car, acting in the nature of an armature, the arrangement of the magnets in the road-bed being such as to alternately present positive and negative poles, thus providing both an attractive and a repelling force exerted upon the magnet of the car to impart to the latter a drawing-and-pushing movement and to change successively the polarity of the car-magnet, whereby the continued forward propulsion of the car is effectually attained and with but a minimum consumption of electric energy.

A further object of the present invention is to provide a simple and effective arrangement of wiring and to include therein simple and efficient means whereby the polarity of the car-magnet may be expeditiously changed to impart to the car either a forward or a backward movement, thus adapting the car as effectually for traction purposes as is the case with an ordinary geared motor-car.

With these general objects in view and others, which will appear, the nature of the improved means or invention consists of a substantially novel construction, combination, and arrangement of parts, as will be hereinafter fully described, illustrated in the accompanying drawings, and pointed out in the appended claims.

While the forms of the invention herein shown and described are what are believed at the present time to be preferable embodiments thereof, it will of course be understood that the invention is susceptible of various changes in the form, proportion, and minor details of construction, and the right is therefore reserved to modify or vary the invention as fully as will come within the spirit and scope thereof.

In the drawings, Figure 1 is a plan view of the road-bed of an electric railway equipped with the herein-described improvements, parts being shown in dotted lines. Fig. 2 is a side elevation of the car-trucks and the current-collecting devices carried thereby, the conduit in which the road-contacts are arranged being shown in vertical longitudinal section. Fig. 3 is a longitudinal section of the track-contacts shown in plan. Fig. 4 is a longitudinal section of one of the current-collectors, parts appearing in plan. Fig. 5 is a vertical cross-section of the road-bed and an end elevation of the car-trucks. Fig. 6 is a central vertical longitudinal section of the road-bed and a car-truck, showing the relation of the current-collector to the road-contacts. Fig. 7 is a diagrammatic view illustrating the wiring. Fig. 8 is a view similar to Fig. 5, illustrating a modified arrangement.

Referring to the details of the drawings, the numeral 10 designates a pair of feed-wires or other conductors, which feed-wires are suitably connected to any suitable source of electric energy, said wires being arranged in a suitable conduit 11, located beneath the surface of the ground and in proximity to the road-bed.

The numeral 12 designates a conduit also located beneath the surface of the ground and having a slot 13, whereby the current-collecting devices carried by the car may be introduced into the conduit and freely travel therein for the purpose of conducting the current for feeding the magnet or magnets of the car. As

here shown, the conduit 12 is located on and secured to the cross-ties 112, and the conduit 11 is beneath the cross-ties. This conduit 12 contains a pair of composite power-conducting rails, each of said rails being formed of a series of sections 15 made of material adapted to conduct the current, while interposed between said conducting-sections is a series of insulators 16, the latter being designed to separate the conducting-sections. By referring to Figs. 3 and 7 it will be observed that the conducting-sections 15 of one of said power-rails are arranged in alternate or staggered relation to the conducting-sections of the other power-rail. It will also be observed that the length of each of the conducting-sections 15 is less than the length of the insulators 16, the purpose of this being to prevent the short-circuiting between two opposite conducting-sections. By reason of the arrangement of the power-rails in the manner noted the formation of the arcs as between the successive conductor-sections of both rails is avoided.

The conductor-sections 15 of one of the power-rails is connected with one of the feed-wires 10, while the conductor-sections of the other power-rail are connected with the other feed-wire, such connection being made through the medium of wires 17, which latter form the windings of electromagnets 18. It will thus be seen that alternate magnets 18 are connected with the same feed-wire 10, thus imparting to the alternate magnets the same polarity. This will be better understood by reference to Fig. 7, wherein the wiring is shown in detail and in which the first magnet is connected with the negative feed-wire 10, the other terminal of the magnet being connected with one of the conductor-sections of the negative section of a rail, while the second electromagnet is connected with the positive feed-wire 10, the other terminal of said magnet being connected with the positive section of the other rail. This alternate connection of the magnets with the feed-wires 10 and the power-rails is preserved throughout the entire length of the trackage.

Arranged upon the car is an electromagnet 19, one terminal of which is connected to a suitable controller 20 through a wire 21, and said controller is connected by a wire 22 with one hinge-terminal of a two-pole double-throw switch 23, the other hinge-terminal of which is connected by a wire 24 to the other terminal of the winding of the magnet 19. Connected with the contacts 25, which form one of the pairs of contacts for the two-pole double-throw switch, are wires 26 and 27, the wire 26 being connected with one of the other diagonally-located contacts 28 of said switch 23, while the wire 27 leads to a pair of traveling contacts 29, which bear upon the power-rails. These traveling contacts are shown as trolleys in Figs. 2, 5, 6, and 8; but a shoe or other well-known contact-piece may be used, if desired. The wire 27 is also connected, through the medium of the wire 30, with the other of the contacts 28, while connected with the wire 26 is a wire 31, which in turn is connected with a pair of traveling contacts 32, the latter also bearing upon the power-rails and working thereover.

It will thus be seen that with the switch 23 in the position shown in the drawings and one of the traveling contacts 32 upon a positive section 15 of a power-rail the current will flow from said section through the contact 32, the wire 31, the wire 26, to one of the contacts 25 of the switch 23, through the latter to the wire 24, to the magnet 19, to and through the controller 20, the wire 22, the other leg of the two-pole double-throw switch 23, the other contact 25, the wire 27, and the contact 29, which is in contact with the negative section of the power-rail. Thus the circuit is complete through the car and the magnet 19 becomes energized. With the switch 23 in the position shown in Fig. 7 a north polarity is imparted to the lower extremity of the magnet 19, and consequently as the positive section of the power-rail immediately in advance thereof brings its magnet into the circuit with a south pole at its upper extremity and the negative section immediately behind brings its magnet into the circuit with a north pole at its upper extremity the car-magnet will be attracted by the one and repelled by the other, both forces acting in a common direction and propelling the car, as indicated by the arrow. The car-magnet 19 therefore moves until directly above the track-magnet in advance. At the same time contact is broken at the ends of the sections, and the traveling contacts 29 and 32 will then move upon positive and negative sections, respectively. The direction of the current around the magnet 19 is therefore reversed. Consequently its polarity, from north to south. The polarity of the track-magnet, formerly in advance, being unchanged, (still south,) the car-magnet is repelled by said track-magnet and attracted by the track-magnet ahead in connection with traveling contact 32. This action continues throughout the course of travel.

The car may be reversed as follows: As soon as the two-pole double-throw switch 23 is shifted into engagement with the contacts 28 the polarity of the car-magnet 19 becomes reversed, and hence as soon as the controller 20 is suitably operated the direction of movement of the car will be the reverse of that when the switch 23 is in engagement with the contacts 25.

The construction of the collecting devices is shown in Figs. 4, 5, and 6, the same consisting of a plate secured to the frame of the car-truck, the center of said plate being preferably in perfect alinement with the center of the car-magnet and to one side of it. To the lower end of said plate the contacts 29

and 32 are connected, said contacts being carried by suitable arms 36. The arms of each pair of contacts 29 are electrically connected together by a wire 34, but insulated at 35 from the plate 33. The same is true of the arms carrying the other pair of contacts, 32. This insulation is to separate electrically the pair of contacts 29 from the pair 32. The conductors 31 and 27 are connected with the arms 36 and pass upwardly to the wiring of the car previously shown and described in detail in Fig. 7.

As stated and as shown in Figs. 1 and 5, two separate series of road-magnets may be employed, in which case a pair of car-magnets are utilized; but, if desired, but a single series of road-magnets may be adopted, as shown in Fig. 8, in which event only one car-magnet is necessary. It will of course be understood that in either event the car-magnets are placed upon each truck of the car.

In the actual embodiment of the invention in practice the conduit 12 may be either arranged as in Fig. 5 or as in Fig. 8. In addition to these arrangements the power-rails may be arranged similar to the conductor-rail of the ordinary third-rail system. Such details, however, will readily suggest themselves in the requirements of actual practice, and the right is accordingly reserved to resort to such changes when the exigencies of the case demand the same.

In the operation of the herein-described system it will be observed that the current whereby the car-magnet is energized is taken directly from the feeders 10 through the track-magnets 18 and also that but two of the track-magnets are energized at a time. Consequently the current from the feeders 10 passes through the two magnets only, so that the energization of more than two track-magnets simultaneously is avoided.

While the invention is primarily designed for the propulsion of railway-cars, it is perfectly obvious that the same is adapted for use in connection with elevators and other bodies.

The use of a pair of power-rails and the staggered relation of the conducting-sections 15 thereof are to prevent arcing as the traveling contacts pass from one conducting-section to another. The traveling contacts are never at the same time in engagement with two conducting-sections 15, as said sections do not overlap, and thereby short-circuiting of the current is prevented.

It may be added that in this system there is no circuit or loss of current in any of the line or track magnets until and only at the passage of a moving car, the other track-magnets being out of use at the time, and the current consumed, therefore, is directly proportional to the speed of the car. No storage battery is required on the car, as the car-magnet is energized from the line-wires through the pair of track-magnets that happen to be at the time beneath the car. The car is in direct connection, therefore, with the power-house at all times. No complicated pole-changing device is necessary that must be operated to keep step with the travel of the car; nor are there any gears to interfere with the high speed or magnetic switch-boxes to flop up and make connection at the time of passage of the car. The car runs equally well in either direction, and the speed control of the car is as economical as with the present ordinary trolley-car controllers.

In this system also the power is not dependent on traction, but acts with a direct pull and push on the car. The result is that there is no slippage of wheels, and the car may be made light, and consequently at smaller cost. By the omission of the armature and the gearing usual in electric cars the cost of repairs is reduced and the noise of the gearing is therefore avoided.

While this invention is shown and described with reference to its use in connection with railway-cars, it may be used for moving elevators or any other kinds of moving bodies. In the claims and in this specification the word "car" is often used as representative of any moving body, and I do not wish, therefore, to be limited to the use of this invention with cars only.

By the term "electromagnetic field" used in this specification is meant the field of force established by a pole of an electromagnet. Hence an electromagnetic field is herein considered to exist in and about each electromagnet. Said term is thus used in contradistinction to the secondary meaning of the term "magnetic field" which exists between two of the track or field magnets, or magnetic fields in the track, and with reference to which secondary magnetic field the electromagnet on the car, or movable magnetic field, is in the nature of an armature.

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

1. In a system for propelling a car or other movable body, a stationary electromagnetic field, an electromagnetic field carried by the car and moved by said stationary field, and means for energizing the movable field from the source of energy employed for the energization of the stationary field.

2. In a system for propelling a car or other movable body, a stationary electromagnetic field, an electromagnetic field carried by the car and moved by said stationary field, and means for energizing the movable field from the source of energy employed for the energization of the stationary field, portions of the stationary field being successively energized in accordance with the travel of the car.

3. In a system for propelling a car or other movable body, a stationary electromagnetic field, an electromagnetic field carried by the

car and moved by said stationary field, and means for successively establishing the circuits in single portions only of the stationary magnetic field whereby the current is caused to flow only in those portions of said field included in such circuits.

4. In a system for propelling a car or other movable body, a stationary electromagnetic field divided into portions of opposite polarity when energized at the passage of the car, the portions of one polarity alternating with those of the opposite polarity, an electromagnetic field carried by the car and moved by said stationary field, and means for energizing the movable field from the source of energy employed for the energization of the stationary field.

5. In a system for propelling a car or other movable body, a stationary electromagnetic field divided into portions of opposite polarity when energized at the passage of the car, the portions of one polarity alternating with those of the opposite polarity, an electromagnetic field carried by the car, and means for successively establishing circuits in single portions only of the stationary magnetic field whereby the current is caused to flow only in those portions of said field included in such circuits.

6. In a system for propelling a car or other movable body, a stationary electromagnetic field divided into portions of opposite polarity when energized at the passage of the car, the portions of one polarity alternating with those of the opposite polarity, an electromagnetic field carried by the car, means for energizing the movable field from the source of energy employed for the energization of the stationary field, and means for successively establishing circuits in single portions only of the stationary magnetic field whereby the current is caused to flow only in those portions of said field included in such circuits.

7. In a system for propelling a car or other movable body, field-magnets located in the track, an armature carried by the car in close proximity to the field-magnets, and means for energizing the armature from the source of energy employed for energizing the field-magnets.

8. In a system for propelling a car or other movable body, a series of field-magnets located in the track, an armature carried by the car in proximity to the field-magnets, and means for energizing said armature from the source of energy employed for energizing the field-magnets, said field-magnets being successively energized in accordance with the travel of the car.

9. In a system for propelling a car or other movable body, field-magnets located in the track, an armature carried by the car in proximity to the field-magnets, and means for establishing a circuit through the armature and through the field-magnets successively as the car travels.

10. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately when energized at the passage of the car, an electromagnet carried by the car in proximity to the track-magnet, and means carried by the car for establishing an electrical connection between the car-magnet and a pair of track-magnets of opposite polarity whereby the car is moved and the polarity of the car-magnet is changed as it passes from one track-magnet to another.

11. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately when energized by the passage of the car, an electromagnet carried by the car in proximity to the track-magnets, and means carried by the car for establishing an electrical connection between the car-magnet and the track-magnets immediately preceding and following the car-magnets.

12. In a system for propelling a car or other movable body, electromagnets along the track or line of travel, a positive feed-wire running to every other magnet and a negative feed-wire running to the remaining track-magnets, an electromagnet carried by the car in proximity to the track-magnets, and means carried by the car for establishing an electrical connection between the car-magnet and a pair of track-magnets of opposite polarity, whereby the car is moved and the polarity of the car-magnet is changed as it passes from one track-magnet to another.

13. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately when energized at the passage of the car, an electromagnet carried by the car in proximity to the track-magnets, and means for energizing the car-magnet from the same electrical energy employed for energizing the pair of track-magnets.

14. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, and means for establishing an electrical circuit temporarily through the pair of track-magnets and the car-magnet.

15. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, and means for bringing the pair of track-magnets and the car-magnet into the same electrical circuit while the car-magnet is passing the track-magnets.

16. In a system for propelling a car or other

movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means for establishing a circuit through the car-magnet with the two nearest track-magnets as the car passes over the track whereby said magnets are energized and the remaining track-magnets are not energized.

17. In a system for propelling a car or other movable body, insulated conductor-sections extending along the track or line of movement, electromagnets connected with said conductor-sections and forming a stationary electromagnetic field, an electromagnetic field carried by the car, and traveling contacts in engagement with said conductor-sections for energizing the movable electromagnetic field.

18. In a system for propelling a car or other movable body, insulated conductor-sections extending along the track or line of movement, field-magnets connected with said conductor-sections, an armature carried by the car, and traveling contacts from said armature in contact with said conductor-sections.

19. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, means for imparting opposite polarity to the magnets connected with the approximate conductor-sections, an electromagnetic field carried by the car, and means for energizing the movable field from approximate conductor-sections.

20. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, means for imparting opposite polarity to the magnets connected with the approximate conductor-sections, an electromagnetic field carried by the car, and traveling contacts in engagement with the conductor-sections for energizing the movable electromagnetic field.

21. In a system for propelling a car or other movable body, a pair of power-rails extending along the track formed of insulated conductor-sections, electromagnets connected with the conductor-sections of said rails and forming a stationary electromagnetic field, an electromagnetic field carried by the car, and traveling contacts in engagement with the power-rails for energizing the movable electromagnetic field.

22. In a system for propelling a car or other movable body, a pair of power-rails extending along the track and formed of insulated conductor-sections, said sections in one rail alternating with the sections of the other rail, an electromagnet connected with each of the conductor-sections of said rails, means for imparting opposite polarity to the magnets connected with the two rails, an electromagnetic field carried by the car, and means for energizing the movable field from the source of energy employed for the energization of the track-magnets.

23. In a system for propelling a car or other movable body, a pair of power-rails formed of insulated conductor-sections, said sections in one rail alternating with said sections of the other rail, an electromagnet connecting each conductor-section of said rails, means for imparting opposite polarity to the magnets connected with the two rails, and traveling contacts in engagement with the power-rails for energizing the movable electromagnetic field.

24. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, a wire connected with every alternate magnet, another wire connected with the remainder of said magnets, so that the approximate conductor-sections will be of opposite polarity, an electromagnet carried by the car in proximity to the stationary magnets, traveling contacts carried by the car and connected with the car-magnet and in engagement with two approximate conductor-sections that establishes a circuit through two of the stationary magnets and the car-magnet for energizing said magnets.

25. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, a wire connected with every alternate magnet, another wire connected with the remainder of said magnets so that the approximate conductor-sections will be of opposite polarity, an electromagnet carried by the car in proximity to the stationary magnets, and traveling contacts carried by the car and connected with the car-magnet and in engagement with two conductor-sections, one of said sections and contacts being in advance of the other section and contact.

26. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, a wire connected with every alternate magnet, another wire connected with the remainder of said magnets so that the approximate conductor-sections will be of opposite polarity, an electromagnet carried by the car in proximity to the stationary magnets, a frame extending from the car over the track, a pair of oppositely-disposed arms pivoted to said frame and insulated from each other, a contact on the end of each of said arms adapted to engage the approximate conductor-sections, one in advance of the other, and wiring from said contacts to the car-magnet so that the current will pass through and energize the car-magnet.

27. In a system for propelling a car or other movable body, conductor-sections along the track or line of movement, an electromagnet connected with each of said conductor-sections, a wire connected with every alternate magnet, another wire connected with the remainder of said magnets so that the approximate conductor-sections will be of opposite polarity, an electromagnet carried by the car in proximity to the stationary magnets, a frame extending downward from the car over the track, arms extending in opposite directions from the lower end of said frame and pivoted thereto and insulated from each other, a trolley on the extreme end of each arm adapted to engage the conductor-sections, one in advance of the other, the distance between the trolleys being substantially the same as the length of a conductor-section, and wiring from said arms to the car-magnet so that the current will pass through the car-magnet and energize the same.

28. In a system for propelling a car or other movable body, a pair of parallel power-rails extending along the track or line of movement and each formed of alternating conductor-sections and insulating-sections, the conductor-sections in the two rails alternating with each other, an electromagnet connected with each conductor-section, a pair of feed or line wires, one running to the magnets connected with one power-rail and the other running to the magnets connected with the other power-rail so that the approximate conductor-sections and magnets will have opposite polarity, an electromagnet carried by the car, and traveling contacts carried by the car and movable on said rails and connected with the car-magnet so that the current from the approximate magnets in the track will pass through and energize the car-magnet.

29. In a system for propelling a car or other movable body, a pair of parallel power-rails extending along the track or line of movement and each formed of alternating conductor-sections and insulating-sections, the conductor-sections in the two rails alternating with each other, an electromagnet connected with each conductor-section, a pair of feed or line wires, one running to the magnets connected with one power-rail and the other running to the magnets connected with the other power-rail so that the approximate conductor-sections and magnets will have opposite polarity, an electromagnet carried by the car, and four traveling contacts, two in advance of the other two and adapted to move along said power-rails and so distanced that the two sets of contacts will engage two approximate conductor-sections in the power-rails simultaneously.

30. In a system for propelling a car or other movable body, a pair of parallel power-rails extending along the track or line of movement and each formed of alternating conductor-sections and insulating-sections, the conductor-sections in the two rails alternating with each other, an electromagnet connected with each conductor-section, a pair of feed or line wires, one running to the magnets connected with one power-rail and the other running to the magnets connected with the other power-rail so that the approximate conductor-sections and magnets will have opposite polarity, an electromagnet carried by the car, a frame extending from the car in proximity to the power-rails, a pair of arms pivoted thereto and extending therefrom and in opposite directions, said arms being insulated from each other, a contact mounted on the extreme end of each arm that engages the power-rails, and wiring from said arms to the car-magnet so that a current will pass through the magnet and energize it.

31. In a system for propelling a car or other movable body, a pair of parallel power-rails extending along the track or line of movement and each formed of alternating conductor-sections and insulating-sections, the conductor-sections in the two rails alternating with each other, an electromagnet connected with each conductor-section, a pair of feed or line wires, one running to the magnets connected with one power-rail and the other running to the magnets connected with the other power-rail so that the approximate conductor-sections and magnets will have opposite polarity, an electromagnet carried by the car, a frame extending from the car in proximity to the power-rails, a pair of arms pivoted thereto and extending therefrom in opposite directions, said arms being insulated from each other, a contact mounted on the extreme end of each arm that engages the power-rails, wiring from said arms to the car-magnet so that a current will pass through the magnet and energize it, and a spring acting on each of said arms to hold the contacts against the power-rails.

32. In a system for propelling a car or other movable body, a pair of parallel power-rails extending along the track or line of movement and each formed of alternating conductor-sections and insulating-sections, the insulating-sections being somewhat longer than the conductor-sections and the conductor-sections in the two rails alternating with each other, an electromagnet connected with each conductor-section, a pair of feed or line wires, one running to the magnets connected with one power-rail and the other running to the magnets connected with the other power-rail so that the approximate conductor-sections and magnets will have opposite polarity, an electromagnet carried by the car, and traveling contacts carried by the car and movable on said rails and connected with the car-magnet so that the current from the approximate magnets in the track will pass through and energize the car-magnet.

33. In a system for propelling a car or other movable body, a stationary electromagnetic

field divided into sections of opposite polarity when energized by the passage of the car, the sections of one polarity alternating with those of the opposite polarity, an electromagnetic field carried by the car, means for energizing the movable field from the source of energy employed for the energization of the stationary field, and means for changing the polarity of the movable magnetic field.

34. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means carried by the car for establishing an electrical connection between the car-magnet and the track-magnets immediately preceding and following the car-magnet, and means for changing the relative polarity of the movable magnetic field and reversing the car.

35. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means for bringing the pair of track-magnets and the car-magnet into the same electrical circuit while the car-magnet is passing the track-magnets, and means for changing the relative polarity of the movable magnetic field and reversing the car.

36. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means carried by the car for establishing an electrical connection between the car-magnet and the track-magnets immediately preceding and following the car-magnets, a pole-changing switch carried by the car, and suitable wiring between it and the car-magnet and the track-magnets whereby the circuit from one track-magnet will pass through the pole-changing switch and car-magnet to the other track-magnet.

37. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means carried by the car for establishing an electrical connection between the car-magnet and the track-magnets immediately preceding and following the car-magnets, a two-pole double-throw switch carried by the car, and suitable wiring between it and the car-magnet and the track-magnets whereby the circuit from one track-magnet will pass through the two-pole double-throw switch and car-magnet to the other track-magnet.

38. In a system for propelling a car or other movable body, electromagnets along the track or line of travel that present north and south poles alternately, an electromagnet carried by the car in proximity to the track-magnets, means carried by the car for establishing an electrical connection between the car-magnet and the track-magnets immediately preceding and following the car-magnet, a pole-changing switch carried by the car, suitable wiring between it and the car-magnet and the track-magnets whereby the circuit from one track-magnet will pass through the pole-changing switch and car-magnet to the other track-magnet, and a controller in the circuit between the magnet and said switch.

In witness whereof I have hereunto affixed my signature in the presence of the witnesses herein named.

ORESTEZ HAMPTON CALDWELL.

Witnesses:
V. H. LOCKWOOD,
NELLIE ALLEMONG.