(No Model.) 3 Sheets—Sheet 1.

A. H. BRINTNELL.

ELECTRIC PROPULSION OF CARS.

No. 557,960. Patented Apr. 7, 1896.

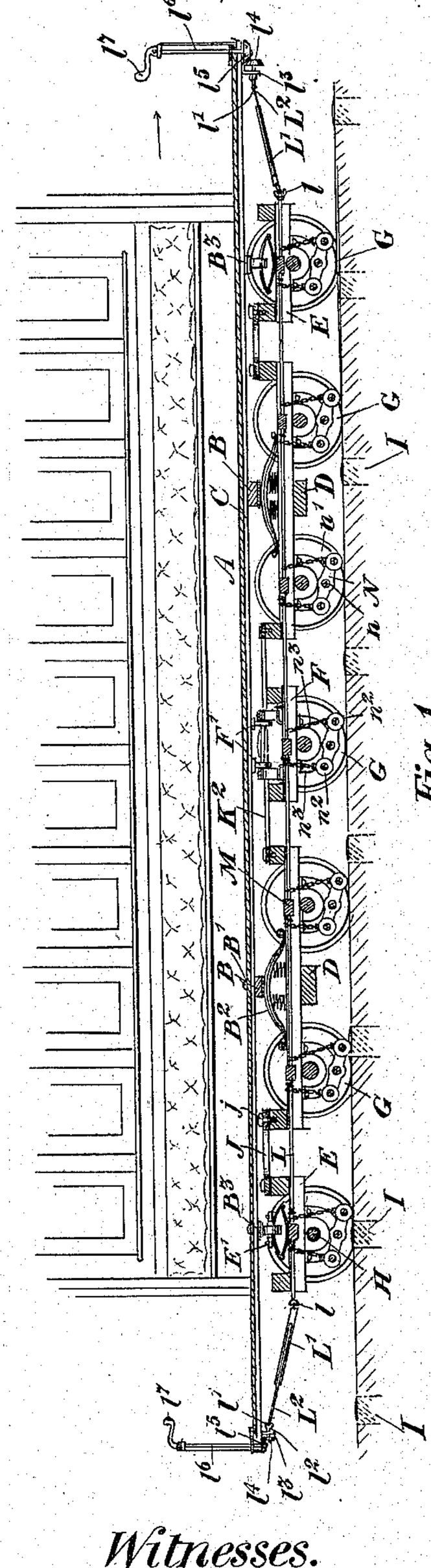

Fig. 1.

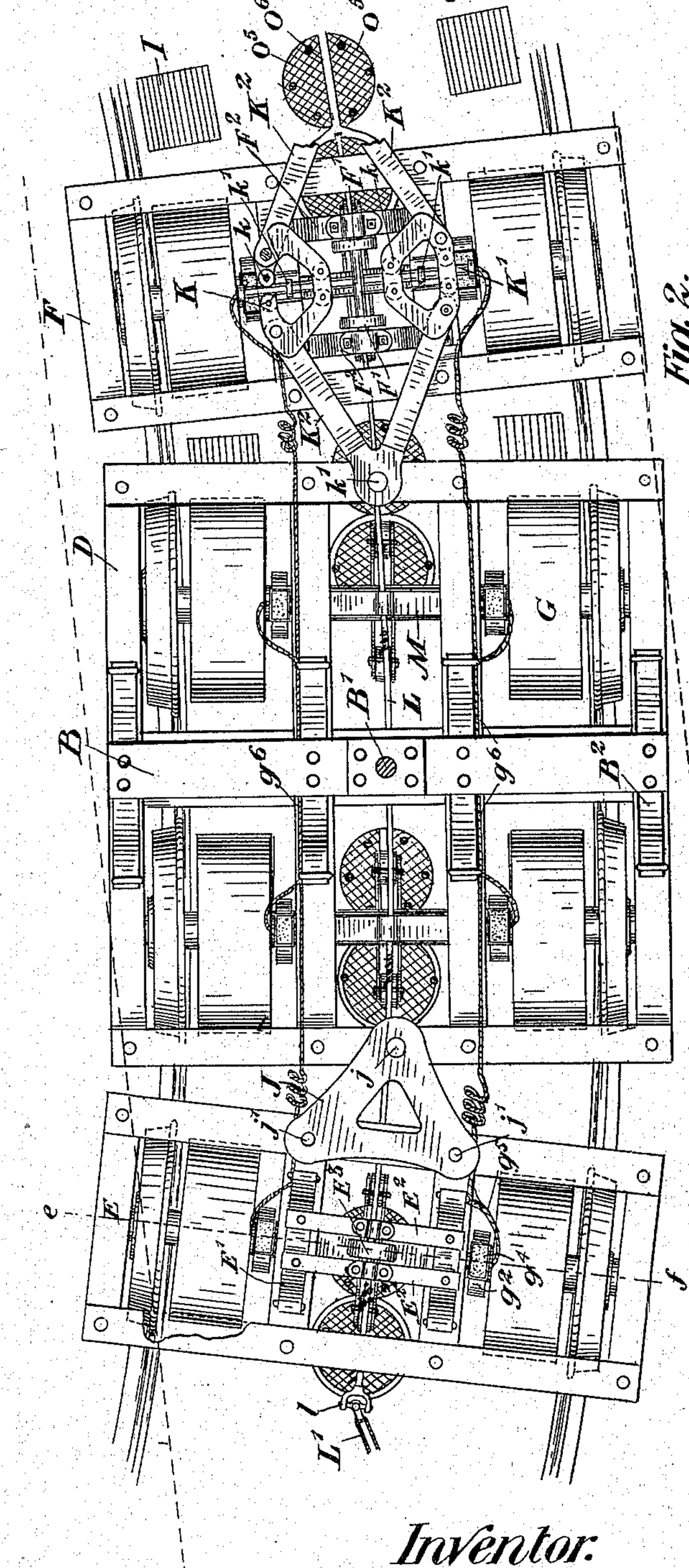

Fig. 2.

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ELECTRIC PROPULSION OF CARS.

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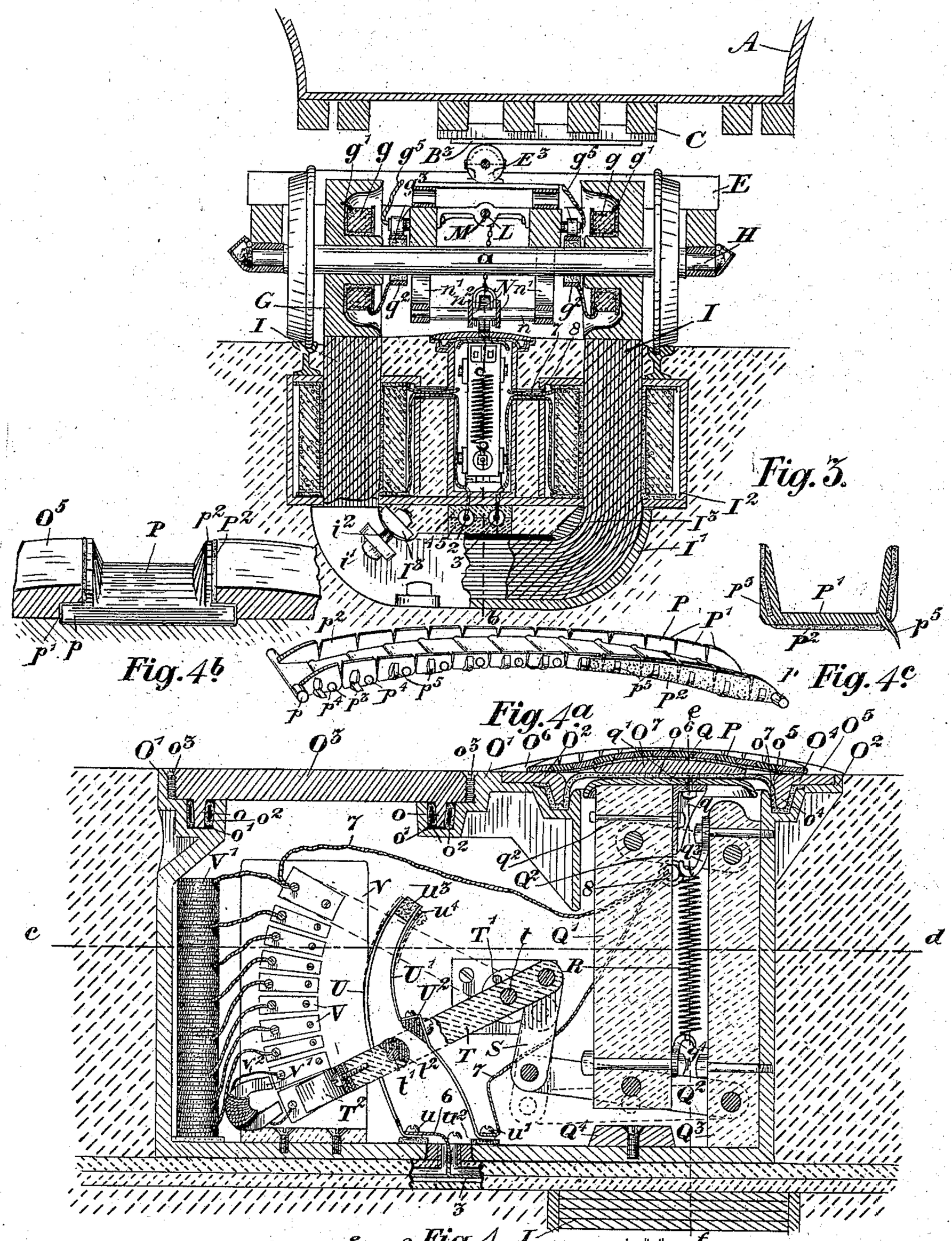

Fig. 3.

Fig. 4b

Fig. 4a

Fig. 4c

Fig. 4.

Fig. 5.

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(No Model.)

3 Sheets—Sheet 3.

A. H. BRINTNELL.

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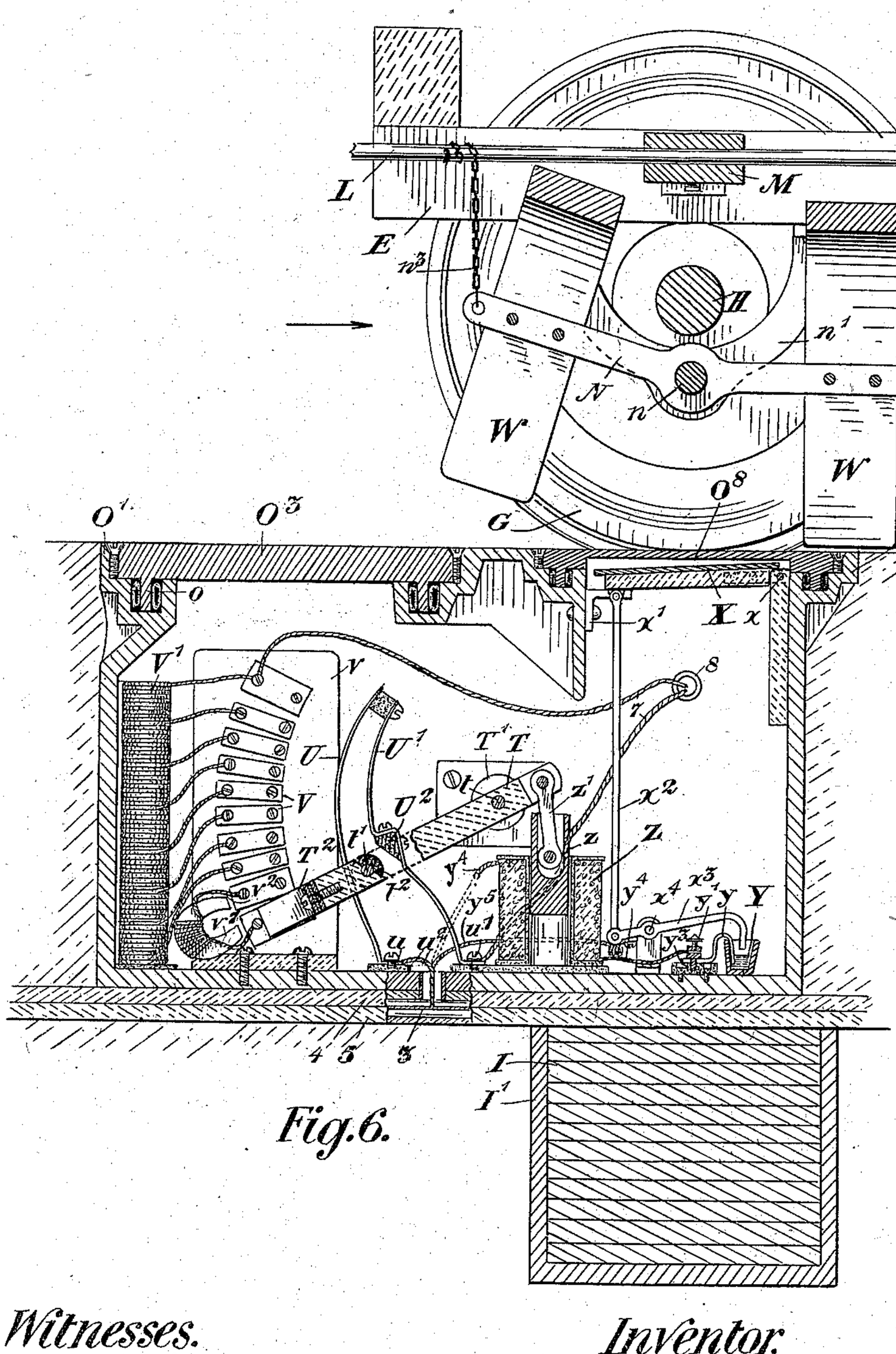

Fig. 6.

Witnesses.
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UNITED STATES PATENT OFFICE.

ARCHIBALD H. BRINTNELL, OF TORONTO, CANADA.

ELECTRIC PROPULSION OF CARS.

SPECIFICATION forming part of Letters Patent No. 557,960, dated April 7, 1896.

Application filed May 1, 1895. Serial No. 547,774. (No model.)

To all whom it may concern:

Be it known that I, ARCHIBALD H. BRINTNELL, of the city of Toronto, in the county of York, in the Province of Ontario, Canada, have invented certain new and useful Improvements in Electric Propulsion of Cars, of which the following is a specification.

My invention relates to improvements in electric propulsion of cars; and the object of the invention is to devise a simple, efficient, safe, and economical system in which there will be no ground-current, practically no magnetic leakage, no overhead poles with exposed wires, and consequently no short circuits, no possibility of burning out, and in which any desired voltage may be used without danger; and it consists, essentially, of a system in which the motor is composed of drum-armatures connected to the car-wheel axles and of field-magnets located at requisite distances apart between the rails of the track, the drum-armatures being designed to be magnetically brought into rolling contact with the field-magnets successively, so as to draw the car forward or rearward, as desired, switch mechanism being also provided for throwing the current into and out of the field-magnets and the parts being otherwise constructed as hereinafter more particularly explained.

Figure 1 is a longitudinal section through a car and portion of the road-bed on a much-reduced scale. Fig. 2 is a plan view showing the major portion of the trucks and the arrangement of the magnets and switch-boxes in the road-bed. Fig. 3 is a cross-section through the line *e f*, Fig. 1. Fig. 4 is a longitudinal section of the switch-box through the line *a b*, Figs. 3 and 5. Fig. 4^a is a perspective view of the yielding contact-plate chain operated by the travelers on the car. Fig. 4^b is an end view of the plate chain. Fig. 4^c is a cross-section through the chain, showing the manner of fastening on the leather wrapping. Fig. 5 is a sectional plan through the line *a b*, Fig. 4. Fig. 6 is a detail of an alternative form of switch-operating mechanism and travelers.

In the drawings like letters and numerals of reference indicate corresponding parts in each figure.

A is the body of the car; B, the cross-timbers; C, the longitudinal timbers; D, the four-wheel truck-frames; E, the outer two-wheel truck-frames, and F the central two-wheel truck-frame. The four-wheel truck-frames are pivoted on the cross-timbers B by the king-bolts B′, and portion of the weight of the car is supported through them upon the semielliptical springs B^2. (See Figs. 1 and 2.) The trucks E E serve also to support portion of the weight of the car by means of the elliptical springs E′, which have journaled between them and on the top of them, on the cross-rods E^2, the roller E^3, upon which the end cross-plates B^3 rests. The remaining portion of the weight of the car is supported upon the central truck F by the rollers F′, which are secured on a spindle journaled in bearings upon the top of the elliptical springs F^2.

G are the drum-armatures, which are secured in pairs upon each of the axles H. Each pair of armatures is secured to each axle, one toward each end and equidistant from the ends of the axle. All the drum-armatures are of the same diameter and are equidistant from each other throughout the length of the car and approach in close proximity to the surface of the road-bed, so as to have a rolling contact upon the horseshoe field-magnets I, the ends of the cores of which are preferably exactly the same width as the peripheral face of the drum and are arranged to come exactly in the path of the same as the drums are attracted to the ends of the core, as hereinafter more particularly explained.

The end trucks E are connected by triangular plate J to the four-wheel trucks, one apex of the triangular plate being pivotally connected by a bolt *j* to the trucks D, and the other apexes being securely held to the cross-bar of the truck E by bolts *j*′. As the trucks are at a short distance apart, this action permits of the free swing of the end trucks as they go around a curve, the roller E^3 serving still to partially support the car as it moves over the cross-plates B^3.

The central truck F has two substantially triangular frames K, located opposite each other in the central portion of the frame. The frames K consist of an upper and lower plate, in which are journaled the friction-rollers *k*. (Shown partially by dotted lines and full lines in Fig. 2.) K′ is a rod which extends through the rollers. The frames K are pivotally con-

nected by bars K^2 to the pivot-bolts k' at the inner ends of the trucks D. The rod K′ is supported in eyebolts k^3 within the openings of the frame K, as indicated. It will thus be seen that in going around a curve, as indicated in Fig. 3, the central portion of the frame—namely, the triangular frames K and connecting-bars K^2—will be permitted a longitudinal extension through the frames K, being caused to move inwardly, the friction-rollers passing along the bar K′. When the car reaches a straight portion of the track, it will be readily seen that the frames K will move outwardly.

L is a metal rod extending from end to end of the car and connected by a universal joint l at each end to a square bar-socket L′. (See Figs. 1 and 2.)

L^2 is a rod which extends into the bar-socket L′ and is connected by a universal joint l' to a spindle l^2, journaled in the bracket l^3, secured to the bottom of the car.

l^4 is a bevel-pinion secured in the outer end of the spindle l^2. The bevel-pinion l^4 meshes with the bevel-pinion l^5, secured on the lower end of the rod l^6, which is provided with a crank-handle l^7.

The rod L is universally jointed and is supported at intervals in bearings M, secured to the central portion of the truck-frame.

N are double-arm travelers pivoted on the rod n, journaled in the hanger-bearings n', secured to the bottom of the truck-frames. The rod n in each case comes directly underneath the center of the axles. The double-arm travelers are preferably provided with friction-rollers n^2 and are connected at each end by chains n^3 to the rod L. The double-arm travelers are placed in such position throughout the length of the car that the chain attached at the same end of each traveler throughout is partially wound upon the rod L, so that all the corresponding ends of the travelers are raised. The lower end of each traveler when in working position is always in close proximity to the ground. The upper ends of the chain n^3 are wound around in the reverse direction on the rod L, so that when the crank-handle l^7 is turned one end of the pivoted traveler will raise and the other lower. When the traveler is horizontal, it is out of the working position. By turning the crank-handle still more the opposite end of the traveler to that shown in the drawings would be thrown down in proximity to the ground.

The end of the traveler which is in close proximity to the ground operates to propel the car in the direction to which this end is downwardly inclined, as will be understood from what is hereinafter described.

The travelers operate the switch mechanism contained in the box O, the peculiarity of construction of which and the operation of the switch contained therein so as to throw the current into the field-magnets I shall now describe.

The upper part of the box O is comprised of two circular flanges O′ and O^2, which are integrally formed, abut each other, and extend beyond the width of the rectangular lower portion of the box, as indicated by full lines in Figs. 3 and 5.

O^3 is a circular metal plate which fits within the circular flange O′ and is provided with a downwardly-extending vertical ring-flange o, which fits within an annular recess o' of a greater width than the flange. Between the inner and outer sides of the vertical flange o and the sides of the recess I insert a rubber or flexible tube-packing o^2, which is pressed nearly flat when the vertical flange is inserted in the recess, and thus serves to form a spring-packing which is perfectly water-tight. The plate O^3, I fasten down by screws o^3, which extend partially into the edges of the flange O′ and partially into the circular plate O^3. The circular flange O^2 has a ring O^4 fitting within it, which has a downwardly-extending flange o^4, fitting within a recess o^5 in the flange O^2.

o^6 is a circular piece of leather or other flexible material formed up, as indicated, and completely covering the circular opening within the ring O^4. The recessed edges o^7 are held within the recess o^5 by the downwardly-extending flange o^4, forming part of the ring O^4, so that the opening is perfectly water-tight.

O^5 is a cap-plate formed in two parts, the concentric edges of which extend over the circular flange O^2. The straight passage-way O^6 is formed between the two portions.

O^7 is a circular plate with a convex top, which fits within a corresponding space formed underneath both portions of the cap-plate O^5.

P is a plate-chain bridge pivoted by the trunnions p at each end in elongated holes p', formed underneath the cap-plates at the edges of and toward the ends of the passage-way O^6. The chain P is comprised of several links P′, which have upwardly-extending sides p^2. Each plate is connected to its adjacent one by trunnions p^3, which fit into recesses p^4 in the adjacent plate.

P^2 is a flexible yielding cover, of leather or other suitable material, which is brought underneath and up the sides of the chain P throughout its length and is fastened by means of teats p^5, which when the leather is being put on are bent down in the position shown at the left-hand side of Fig. 4^a and at the right-hand side of Fig. 4^c, the points of the teats p^5 extending through the leather, which is forced over the teats. When the leather has been placed in position over the teats from end to end, such teats are bent up into the position shown at the right-hand side of Fig. 4^a and at the left-hand side of Fig. 4^c, so that the outer side of the teats are flush with the outer side of the leather. The leather covering P^2, formed and secured in position as above described, is for the purpose of pre-

venting any foreign matter getting down in the passage-way O^6 and yet permit of the free upward and downward movement of the chain as caused by the traveler, as hereinafter described.

Q is a plate secured on the top of the vertically-moving block Q′ by means of a bracket q, bolts q' and q^2, as shown. The block Q′ is pivotally connected by the links Q^2 to the vertical block Q^3, which is bolted to the side of the rectangular box or casing Q.

R is a spiral spring connected at the upper end to the hook q^3, attached to the vertical block Q^3, and at the lower end to the hook q^4, attached to the vertically-moving block Q′.

Q^4 is a buffer secured to the bottom of the casing, and is designed to limit the downward throw of the block Q′. There are two pairs of links Q^2, one of each pair extending on each side of the blocks Q′ and Q^3. The lower pairs of links, or, more properly, levers Q^2, extend beyond the pivotal connection to the block Q′, the ends being pivotally connected by a pair of links S to the short arm of the lever T, pivoted on the pin t, extending out from the bracket T′. The lever T is of insulating material and has pivoted on a pin t', extending through it, two carbon rollers t^2, one at each side.

U U′ are quadrantal contact-plates secured at the bottom by the screws u and u' to insulating-plates u^2 and u^5, secured to the bottom of the box.

w^3 is an insulating-block secured by a screw u^4 to the quadrantal strip U′.

It will be noticed that the quadrantal strip U′ is farther from the strip U at the lower portion and that in the dip, where it recedes from the strip U, I secure a bevel carbon contact-block U^2.

Upon the end of the long arm of the lever H, I secure semiloop-shaped metal contact-strips T^2, which are designed to be successively brought in contact from bottom to top with the commutator-sections V of the resistance-coil V′, which are connected to them as shown. The commutator-sections are in quadrantal form and are secured to the insulating standard-plates v.

v' are horseshoe-magnets which bridge the two lower commutator-sections on each side and have wires v^2 passing from the one section to the other around the horseshoe-magnets. These magnets v' are designed to blow out the arc formed by the loop-shaped metal contact-strips T^2 between the two lower sections as they descend, as hereinafter explained.

The magnetic lines of force passing from the positive to the negative pole of the magnet produce a rapid current in the atmosphere at right angles to the course the electric current would take between the two contact-points and by this means blows out the arc. In other words, the electric current is broken from its point of contact and cannot act upon the particles of atmosphere, and consequently cannot form an arc.

2 and 3 are the positive and negative wires of the main circuit, which pass through a conduit, preferably comprised of boards 4 and 5, placed together, as shown. The bottom end of the horseshoe-magnet I is inclosed by a casing I′, which extends around the bottom and two sides of the lower portion of the magnet and up as far as the inclosed magnet-coils I^2.

I^3 are cross-bars with convex inner sides extending across the corners of the core of the magnets on the inside, and i are lugs formed parallel to these cross-bars on the casing I′.

i^2 are bolts securing and binding the casing and cross-bars together, so as to keep the casing close up to the core of the magnet.

Between the cross-bars I^3 is an open space above the core of the magnet, which I preferably fill with pitch or other insulating and waterproof material, so as to prevent the core from becoming rusted.

In Fig. 4 the negative wire 3 is shown in the broken section of the conduit 4 5. A branch wire 6 leads from the wire 3 to the binding-screw u, securing the bottom of the quadrantal plate U on this side of the lever T. A wire 7 leads from the binding-screw u' at the bottom of the quadrantal plate U′ on this side through the tubular conduit 8, magnet-coil I^2, back through the conduit 8 to and through the several commutator-plates V and resistance-coils V′. Upon the opposite side the wiring leading from the positive wire 2 is exactly similar. (See Figs. 3, 4, and 5.)

It will now be seen that when the travelers N are in the position shown in Fig. 1, and when the friction-roller n^2 of each traveler reaches the circular divided plate O^5 and passes along the passage-way O^6 it being in close proximity to the ground will ride upon the chain bridge and press it downwardly, thereby throwing down the vertical block Q′, tilting the double arm Q^2 on its pivot, thereby throwing up the long end of the lever T over the commutator-sections and at the same time throwing the carbon contact-rollers t^2 against the carbon contact-blocks U^2, thus electrically bridging the quadrantal plates U and U′ from the period that the rollers t^2 reach the carbon blocks U^2 until the lever is thrown its full swing, thus gradually throwing in the current through the commutator-sections V. The current will pass during this period from the positive wire 2 through the wire 6, quadrantal plate U, contact-roller t^2, quadrantal plate U′, wire 7, through the magnet-coils on the opposite side to that shown in Fig. 4, back to the commutator-sections and resistance-coils, thence by the loop-shaped strips T^2 to the positive commutator-sections and resistance-coils V and V′, respectively, thence by the wire 7 through the other magnet-coil, then back to the other quadrantal plate U′, carbon roller t^2, and quadrantal plate U and wire 6, to the negative wire 3, as shown in Fig. 4. The effect of the current passing through in the course above described is to magnetize the cores I and cause them to exert a magnetic pull upon

the drum-armatures G in immediate proximity to the left of such magnet. In this instance the acting magnets would be the third from the left, as shown in Fig. 1.

The operation of the successive travelers from left to right in throwing in the switch is exactly identical, and the drum-armatures are so spaced in relation to the magnets that the switch mechanism between the magnets, two at a time, will successively cause the magnets I to exert a pull upon the drum-armatures from left to right, so as to cause the car to travel in the direction indicated by arrow.

When the travelers are tilted in the opposite direction, it will readily be understood that the operation of the switch mechanism for magnetizing the magnets will cause such magnets to exert the same pull in the opposite direction, and thus propel the car in such direction.

In Fig. 6 I exhibit an alternative form of travelers, in which I provide horseshoe-magnets W, secured to the double-arm traveler. A perfectly-plain circular top O^8, flush with the road-bed, is provided to fit within the circular flange O^2.

Instead of the mechanism shown and described as to the former figures used in connection with the rollers on the traveler I provide the following:

X is a hinged plate, preferably cf soft iron, pivoted at one end at x and having a stop x' underneath the opposite end to prevent its falling too far.

x^2 is a rod connected to a lever x^3, pivoted at x^4.

Y is a mercury-cup situated underneath the bent end of the lever x^3.

y is a bent strip which extends into the mercury-cup at one end and under the binding-screw y' at the other, which binding-screw is secured to an insulating-plate y^3. The binding-screw is connected by a wire y^4 to a solenoid Z, and passes out therefrom to the positive wire 2, as indicated by the partially-full lines and partially-dotted lines in this figure.

y^5 is a wire leading from the negative wire 3 to the end of the lever x^3.

The plunger z of the solenoid is connected by a link z' to the lever T.

The operation of this magnetic form of switch mechanism is as follows: As the horseshoe-magnet comes into proximity with the circular plate O^8 above the hinged plate X the said hinged plate is caused to rise, thus throwing the end of the lever x^3 into the mercury-cup Y and completing the circuit through the wire y^4, the solenoid Z, wire y^3, binding-post y', metal strip y, mercury-cup Y, lever x^3, and wire y^5 to the negative wire 3, thus causing the plunger of the solenoid to move downwardly and throw the lever upwardly in the manner hereinbefore described, so as to throw the current into the horseshoe-magnets I, which will operate in the manner set forth to attract the drum-armatures and cause them to have a rolling contact over the ends of the cores of the magnets.

What I claim as my invention is—

1. A system for electrical propulsion of cars comprising a motor, the armatures of which consist of a series of pairs of drums connected with the axles of the car and the field-magnets of which are located in the road-bed and substantially flush therewith and are designed to exert a magnetic pull on the drum-armatures through the current successively switched into them, so that such drum-armatures will have a rolling contact over the magnets as and for the purpose specified.

2. A system for electrical propulsion of cars comprising a series of pairs of drum-armatures secured on the axles of the car, which are located equidistant from each other, a series of field-magnets the tops of the cores of which are substantially flush with the road-bed in the paths of the drum-armatures and are equidistant from each other a series of travelers pivoted directly beneath the axles of the cars and designed to coact with a commutator-switch suitably inclosed and having the top substantially flush with the road-bed to close the main circuit through each field-magnet as the drums approach the ends of the cores as and for the purpose specified.

3. The combination with the magnets situated in the road-bed and substantially flush therewith and the armatures designed to have a rolling contact with the ends of the magnets as specified, of pivoted travelers corresponding in number to the drum-armatures, a switch-box and coacting mechanism in the same operated by each successive traveler to throw in the switch and cause the current to travel from the main wire through the magnets as and for the purpose specified.

4. The combination with the magnets situated in the road-bed and substantially flush therewith and the armatures designed to have a rolling contact with the ends of the cores of the magnets as specified, of pivoted travelers corresponding in number to the drum-armatures a switch-box provided with a flexible chain bridge designed to be depressed by the traveler as it passes over it and means whereby the depression of such chain of each successive switch-box throws in the switch and causes the current to travel from the main wires through the magnets as and for the purpose specified.

5. The combination with the magnets situated in the road-bed and substantially flush therewith and the armatures designed to have a rolling contact with the ends of the cores of the magnets as specified, of pivoted travelers corresponding in number to the drum-armatures, a switch-box and mechanism coacting with the travelers and means for holding the corresponding ends of the travelers at the same time in proximity to the ground as and for the purpose specified.

6. The combination with the magnets situ-

ated in the road-bed and substantially flush therewith and the armatures designed to have a rolling contact with the ends of the cores of the magnets as specified, of pivoted travelers corresponding in number to the drum-armatures, a switch-box and mechanism coacting with the travelers and a universally-jointed rod extending from end to end of the car and connected by chains to both ends of the travelers and means for turning such rod as and for the purpose specified.

7. The combination with the magnets situated in the road-bed and substantially flush therewith and the armatures designed to have a rolling contact with the ends of the cores of the magnets as specified, of pivoted travelers corresponding in number to the drum-armatures, a switch-box and mechanism coacting with the travelers and a universally-jointed rod extending from end to end of the car and connected by chains to both ends of the travelers and the square bar-socket, L′, square rod, L^2, universal joint, l', spindle, l^2, bevel-pinions, l^4, l^5, rod, l^6, crank-handle, l^7, all arranged as and for the purpose specified.

8. The combination with the car provided with armatures and the road-bed provided with magnets, the ends of the cores of which are flush therewith, of the travelers, flexible chain bridge supported upon the spring-held block, Q′, and connected by links, Q^2, to the block, Q^3, the links, S, lever, T, provided with carbon rollers, t^2, at each side, the two pairs of quadrantal plates, U, and, U′, insulated from each other and electrical connections from the main-circuit wires to the quadrantal plates, U, and from the quadrantal plates, U′, to and through the magnets as and for the purpose specified.

9. The combination with the car provided with armatures and the road-bed provided with magnets, the ends of the cores of which are flush therewith, of the travelers, flexible chain bridge supported upon the spring-held block, Q′, connected by links, Q^2, to the block, Q^3, the links, S, lever, T, provided with carbon rollers, t^2, at each side, the two pairs of quadrantal plates, U, and, U′, insulated from each other, the carbon blocks, U^2, situated in the depressions of the quadrantal plates, U′, and electrical connections from the main-circuit wires to the quadrantal plates, U, and from the quadrantal plates, U′, to and through the magnets as and for the purpose specified.

10. The combination with the car provided with armatures and the road-bed provided with magnets, the ends of the cores of which are flush therewith, of the travelers flexible chain bridge supported upon the spring-held block Q′, connected by links, Q^2, to the block, Q^3, the links, S, lever, T, provided with carbon rollers, t^2, at each side, the two pairs of quadrantal plates, U, and, U′, insulated from each other, the metal loop-shaped contact-strips, T^2, on the end of the lever, T, the commutator-sections, V, and resistance-coils, V′, and electrical connections from the main-circuit wires to the quadrantal plates, U, and from the quadrantal plates, U′, to and through the magnets as and for the purpose specified.

11. The combination with the car provided with armatures and the road-bed provided with magnets, the ends of the cores of which are flush therewith, of the travelers flexible chain bridge supported upon the spring-held block, Q′, connected by links, Q^2, to the block, Q^3, the links, S, lever, T, provided with carbon rollers, t^2, at each side, the two pairs of quadrantal plates, U, and, U′, insulated from each other, the metal loop-shaped contact-strips, T^2, on the end of the lever, T, the commutator-sections, V, and resistance-coils, V′, and the horseshoe-magnets having the two poles opposite the two lower commutator-sections, and electrical connections from the main-circuit wires to the quadrantal plates, U, and from the quadrantal plates, U′, to and through the magnets as and for the purpose specified.

12. The combination with the car provided with armatures and the road-bed provided with magnets, the ends of the cores of which are flush therewith, of the travelers flexible chain bridge supported upon the spring-held block, Q′, connected by links, Q^2, to the block, Q^3, the links, S, lever T, provided with carbon rollers, t^2, at each side, the two pairs of quadrantal plates, U, and, U′, insulated from each other, the metal loop-shaped contact-strips, T^2, on the end of the lever, T, the commutator-sections, V, and resistance-coils, V′, and the horseshoe-magnets having the two poles opposite the two lower commutator-sections, the wires, 6, connecting the positive and negative wires of the main circuit to their corresponding quadrantal plates, U, the wires, 7, leading from the quadrantal plates, U′, to and through the coils of the horseshoe-magnet, I, and through the commutator-sections, V, and resistance-coils, V′, as and for the purpose specified.

13. The combination with the armatures, magnets and travelers, of the divided cap-plate, O^5, provided with a straight passage-way, O^6, and the flexible chain bridge, P, formed and held by trunnions at each end and switch mechanism operated therefrom as and for the purpose specified.

14. In a system such as described the combination with the switch-box having the cap-plates, O^5, and central passage-way, O^6, of the chain, P, each link of which has upwardly-extending sides and is connected to the adjacent link by trunnions extending into holes in such link as and for the purpose specified.

15. In a system such as described the combination with the switch-box having the cap-plates, O^5, and central passage-way, O^6, of the chain, P, each link of which has upwardly-extending sides and is connected to the adjacent link by trunnions extending into holes in such link and a leather covering extending around the bottom and sides of the chain and

held in position thereto by the teats, p^5, as and for the purpose specified.

16. In a system such as described the switch-box provided with the chain bridge located as specified, of the circular flange, O^2, circular ring, O^4, with downwardly-extending flange, o^4, the circular leather and the spring-held vertical block, Q′, and its connections all operating as and for the purpose specified.

17. A switch-box for the purpose described having two top annular flanges with a space or channel between, in combination with a top plate having a depending flange fitting within said recess, and a yielding packing located upon each side of said depending flange, substantially as described.

18. The combination with the trucks, D, E, F, of the triangular plates, J, pivotally connected to the four-wheel trucks and rigidly connected to the outer two-wheel trucks and the adjustable frames, K, supported on the central truck F, and having friction-rollers, k, the guide-bar, K′, bars, K^2, pivotally connecting the frames, K, to the pivot-bolts on the four-wheel trucks as and for the purpose specified.

19. The combination with the horseshoe field-magnets formed as specified, of the casing, I′, cross-bars, I^3, lugs, i, and bolts, i^2, as and for the purpose specified.

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