(No Model.)

2 Sheets—Sheet 1.

E. M. BENTLEY.

ELECTRIC RAILWAY.

No. 359,050. Patented Mar. 8, 1887.

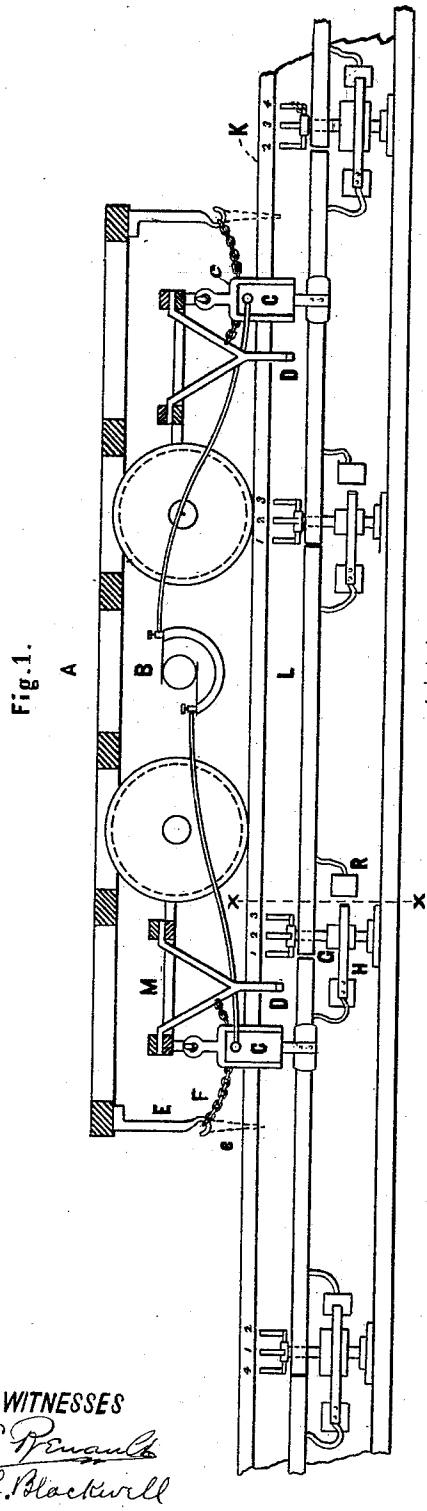

Fig. 1.

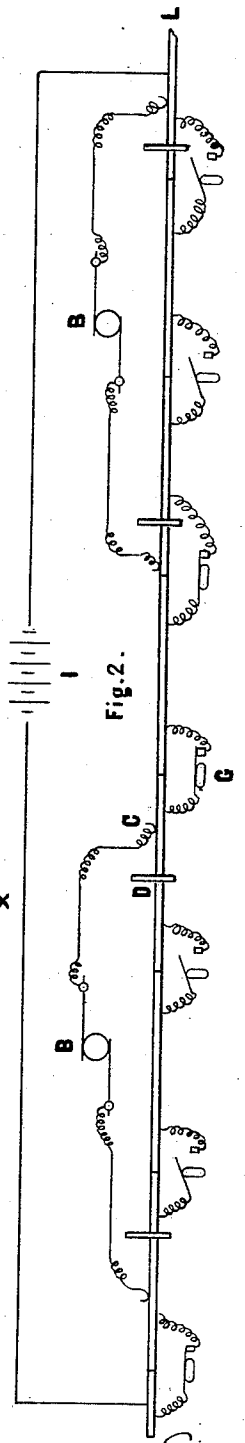

Fig. 2.

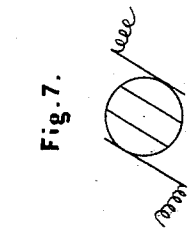

Fig. 7.

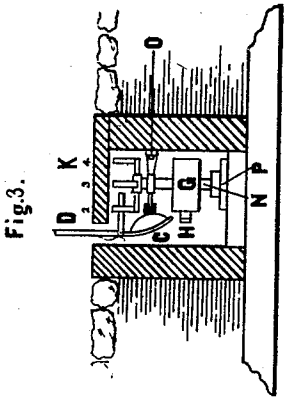

Fig. 3.

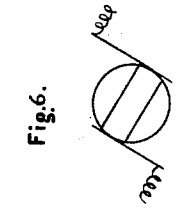

Fig. 6.

WITNESSES

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(No Model.) 2 Sheets—Sheet 2.

E. M. BENTLEY.

ELECTRIC RAILWAY.

No. 359,050. Patented Mar. 8, 1887.

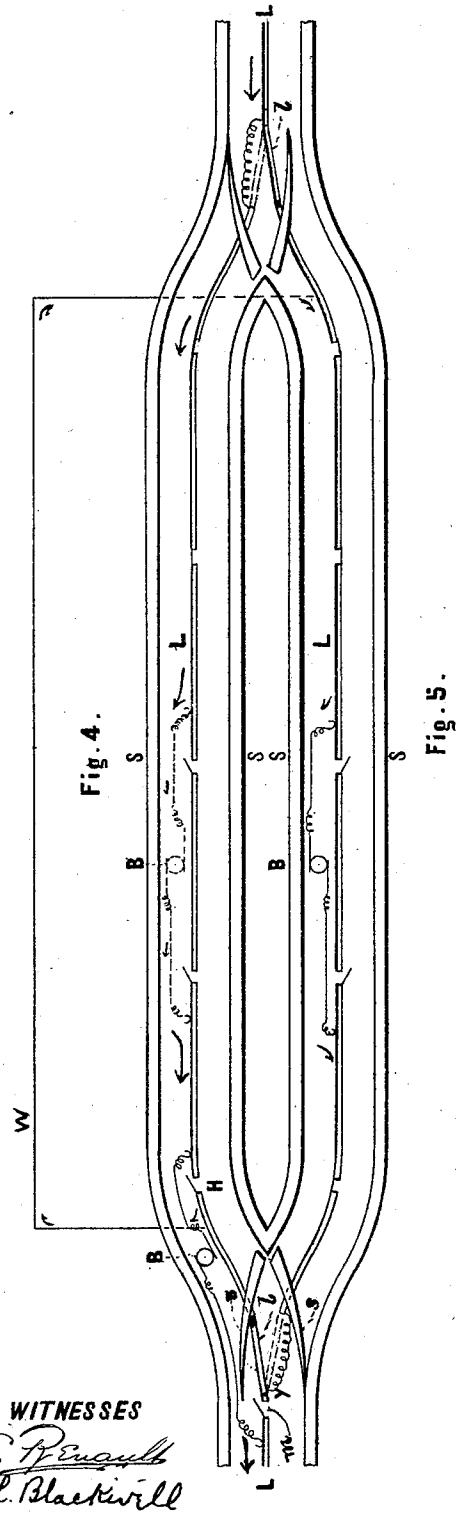

Fig. 4.

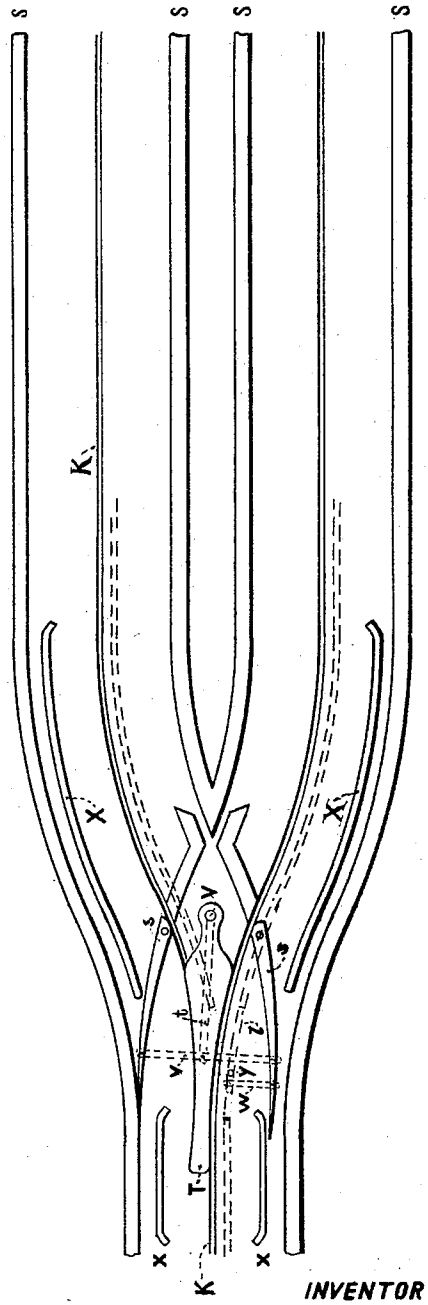

Fig. 5.

WITNESSES

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UNITED STATES PATENT OFFICE.

EDWARD M. BENTLEY, OF BROOKLYN, NEW YORK.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 359,050, dated March 8, 1887.

Application filed October 14, 1884. Serial No. 145,534. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. BENTLEY, a citizen of the United States, residing at Brooklyn, New York, have invented certain new and useful Improvements in Electric Railways, of which the following is a specification.

My invention relates to electric railways in which the locomotives, consisting each of a vehicle and a propelling electric motor therefor, are in series, each one continuously bridging a break in an electric circuit; and it consists in the use of a single sectional conductor independent of the rails and inclosed in a slotted casing or conduit, with contact shoes or brushes extending into the conduit to make contact with said conductor at successive points, and with projections extending from the car to operate a series of switches which normally bridge the sections of the conductor, and which are operated by the passage of the car in either direction, so as to have a break under each car, which the propelling-motor continually subtends.

It also consists in a turn-out and switch for single-track roads.

In the accompanying drawings, Figure 1 is a side view of the conduit and a vertical longitudinal section of the car. Fig. 2 is a diagram of the circuits. Fig. 3 is a cross section of the conduit on line *x x*, Fig. 1. Fig. 4 is a diagram of my turn-out, and Fig. 5 is the switch therefor. Figs. 6 and 7 show a modified electric switch.

A represents the frame of a vehicle—for example, an ordinary street-car.

B represents the propelling electric motor, suspended between the axles and geared to the wheels in a well-known manner.

K is the slotted conduit, placed between the rails with its slot flush with the surface of the street or road. On the wall of the conduit is the conductor L, which is divided into insulated sections somewhat shorter than the distance between the contacts C C at either end of the car. These contacts C C are of the general type shown in Patent No. 305,731, issued to W. H. Knight September 23, 1884, and consist each of a steel frame or casing, *c*, in which is held the insulation in which the conductor leading to the contact-shoe is embedded. From the upper end of the said conductor there is a connection leading to brushes of motor B. These carriers are suspended by hooks, as shown, from the framing M, which is fast to the journal-boxes of the car, and chains F prevent their swinging out of contact with L. This manner of suspending the carriers allows of their lateral movement to permit them to follow the slot in rounding curves, and as they have thus a chance of slight rotative motion about a vertical axis through their point of suspension, they can, though separated a distance greater than the wheel-base of the car, slide around the curving slot without difficulty. The successive breaks in conductor L are each one normally bridged by a spring switch-plate, H, which rests on a plate, R. Behind H is a double-pivoted cam, G, which, when rotated a one-half turn, lifts and lowers H from and to the plate R, the first quarter-rotation lifting and the second quarter lowering it.

The bearings for the spindle N, on which the cam is fixed, are O and P, the former being fastened to the side wall and the latter to the bottom of the conduit. On the upper end of N are four radial arms, from the ends of which project at right angles the vertical roller-arms 1, 2, 3, and 4. From each end of the car, between the two brushes, is a projecting rod, D, extending into the conduit-slot and having at its lower end a short pivoted section, which is held by a spring at right angles to main part or shank of D, so that as D progresses it will strike one of the arms 1 2 3 4 and give spindle N and cam G a quarter-turn. The spring point on the end of D allows of the rod being withdrawn from the slot at will, or, in case of accident D, if necessary, can have a slight lateral movement by sliding on horizontal guides in frame M.

Suppose, now, that a switch, H, is closed and arm 1 is in the path of D, as is shown in the switch at the extreme left of Fig. 1, the radial arms corresponding to 2 and 4 being in line with the major axis of G, while those of 1 and 3 are in line with the minor axis. Then a projection D, passing from right to left of Fig. 1, would strike 1 and throw it into the position shown in the two intermediate switches, thereby giving G a quarter-turn and opening the switch. The cam being then left in that position a second projection D coming along would strike 2 and give the spindle

and cam a second quarter-turn and close the switch again. The switch is thus actuated positively in each direction.

If the two projections are placed on opposite ends of the car, between the contacts C C, yet at a distance apart somewhat greater than the length of a section of L, so that one switch will be opened before a preceding one is closed, there will always be a break in L between C and C, and the current be forced to go through motor B. This action will take place, in whichever direction the car may be passing, so that it can move forward and backward with equal facility, and thus permit the use of a single track for cars going in both directions.

Any practicable number of cars or locomotives may be running at successive points along the line independently of one another, though always in series on the same circuit. This is shown in Fig. 2, where the end sections are connected to generator I and the current passes through two motors B in succession.

For a single track, with locomotives going in both directions, it is necessary, of course, that turn-outs should be provided for allowing them to pass one another at certain points. My turn-out is shown in Figs. 4 and 5.

In Fig. 4 S S are the supporting-rails, and L is the sectional conducting-rail. S S are branched in the usual manner, and *s s* are two switch-points adapted to be moved to throw the vehicle onto one track or the other. In each branch of the conduit is an insulated conductor, the same as that in the main conduit, and connected therewith, which may be spoken of, for convenience, as the "upper" and "lower" branch conductors.

The circuit is normally sent from the main conductor L at beginning of turn-out through one branch conductor, then back by external wire, W, to beginning of turn-out again, and through the other branch conductor to main conductor L at end of turn out, so that the two branches, with any number of locomotives that may be in them, are in series with each other. Thus from L at right-hand end of turn-out the circuit is to upper branch, to wire W, (all switches H being closed,) to right-hand end of lower branch, and to L at left-hand end of turn-out.

A movable section, *l*, at each of the two branching points is adapted to be turned in either direction, as shown by full and dotted lines, to carry the sliding brush onto the conductor of either branch. In the position shown by full lines the sections *l* are insulated from the succeeding part of the conductor in the branch to which they point, so that the described course of the current may be maintained.

Fig. 5 shows the external arrangement at the switch. *s s* are the switching-points, and K represents the conduit, the slot only being seen. At the point where the slot branches is a pivoted plate, T, which may be turned in either direction to close one slot and leave a free passage into the other. T is pivoted on spindle V, which has at its lower end a radial projection, *t*, which engages with and operates connecting-bar *v* between the switching-points *s s*. The section *l* is also swung by the same movement, being pivoted at *y* and connected with *v* by link *w*. X X are guard-rails, and the slots are continued across rails S S. By this arrangement, whenever a locomotive comes from a branch onto the main track its depending brush-carrier or a projection, *e*, throws T to one side, and thereby automatically turns the switch and the section *l* into the proper position for leading it onto the main track, and leaves it so that a returning locomotive will take that branch, so that if two locomotives were running back and forth over a road with a turn-out in the middle they would automatically pass each other on each side alternately.

In the diagram, Fig. 4, one car B is shown waiting on the lower branch and one is just entering the upper branch. As long as the entering car is bridging the break *m* between *l* and succeeding conductor L the other car will be entirely cut out of circuit, the current going, as indicated by large arrows, from L right to upper L, to upper B, to L left; but when the break *m* and section *l* is passed, and upper B is in the position shown by dotted lines, the circuit is, as shown by small arrows, by course before described, to upper B, thence to W, to lower L, to lower B, to L left, the two locomotives being thus in series.

I do not limit myself to the form of electric switch shown. Any other suitable kind may be used—as, for instance, that shown in its closed and open positions, respectively, in Figs. 6 and 7, and which is of a kind well known in electrical constructions.

My arrangement, by which the contact bears on the side of the conductor, the latter being supported at intervals from the walls of the conduit, while the switches move horizontally, tends to economize the limited space within the conduit. The horizontal movement of the switches also renders them less liable to be affected by the vertical play of the contacts and switching-rods. By placing the contacts and switching-rods so that they will extend outside the wheel-base of the car, and at the same time giving them a lateral movement to accommodate them to curves in the slot, I am enabled to employ a longer section of conductor, and hence there will be fewer contacts in the line than if I brought them close to the axles without the lateral play. Both contacts and switch-rods have a range embracing such a longitudinal distance that two switches may be open at once and a whole section bridged by the contacts.

This principle of contact devices and circuit-controllers having a range greater than the wheel-base of a vehicle, but capable of lateral movement relative thereto, may be applied to any series road wherein the conductor-sections

are somewhat shorter than the distance embraced by the contacts, so that there may always be a break between the contacts, and in which it is desirable to have as few sections as possible.

I do not claim herein a contact-plow extending into a slotted conduit and having an independent projection or guard extending from the vehicle into the conduit in advance of the plow so as to protect it from injury. Such a device is shown and claimed in a pending application, and it is hereby disclaimed with reference to this case.

I claim—

1. The combination, with the sectional conductor, of the slotted inclosing-case, inclosed switches controlling the connection between the sections, and operating devices for said switches extending into the inclosure.

2. The combination, with the sectional conductor, of two or more electric locomotives, each bridging a break in said conductor, and rotary switches controlling connection between sections of said conductor and adapted to be operated by the said locomotives.

3. The combination, in a series electric railway, of a sectional electric conductor having normally a switch-connection between the sections, and two opening and closing devices for said switches separated a distance apart equal at least to the length of the conductor-sections, the switches being inclosed, and the opening and closing devices being also inclosed, but connected to an electrically-propelled vehicle outside of the inclosure.

4. The combination, in a series electric railway, of a sectional conductor inclosed in a conduit and supported at intervals from the walls thereof and having a normal switch-connection between the sections, an electrically-propelled vehicle outside of the conduit, and two opening and closing devices separated a distance apart equal at least to the length of the conductor-sections and extending into the conduit to said switches, so as to operate them by a forward or backward movement of the said vehicle to which they are connected.

5. The combination, in a series electric railway, of a main sectional conductor having a series of inclosed switch-connections between the sections, an electrically-propelled vehicle on the railway, and an operating device for said switch-connections connected to said vehicle and extending into the inclosure.

6. The combination, in a series electric railway, of a slotted conduit inclosing a series of switch-connections between the sections of the main conductor, an actuating device for said switch-connections inclosed in the conduit, and a shank extending through the slot of the conduit to connect the actuating device with an electrically-propelled vehicle on the railway.

7. The combination, in a series electric railway, of a series of inclosed switch-connections between the sections of the main conductor, and an actuating device therefor supported from an electrically-propelled vehicle without the inclosure.

8. The combination, in a series electric railway, of an inclosed sectional conductor having normally-closed switch-connections between its sections, and means for working said switch-connections and making contact with the conductor depending into the inclosure from an electrically-propelled vehicle outside of the inclosure.

9. The combination, in a series electric railway, of a main sectional conductor inclosed in a conduit and having switches movable horizontally and normally completing the electrical connection between the sections, and an operating device for said switches extending from an electrically-propelled vehicle into the conduit.

10. The combination, in a series electric railway, of a main sectional conductor inclosed in a conduit and having switches movable horizontally and laterally and adapted to normally complete the connection between the sections, and an operating device for said switches extending from an electrically-propelled vehicle into the conduit.

11. The combination of a series of spring-switches movable horizontally, inclosed in a slotted inclosure, and normally maintaining the electrical connection between the sections of the main conductor of a series electric railway, and an operating device for said switches extending from an electrically-propelled vehicle into the conduit.

12. The combination of a series of spring-switches movable horizontally and laterally, inclosed in a slotted inclosure, and normally maintaining the electrical connection between the sections of the main conductor of a series electric railway, and an operating device for said switches extending from an electrically-propelled vehicle into the conduit.

13. The combination, in a series electric railway, of a main sectional conductor inclosed in a conduit and having a series of switch-connections between the sections, and a contact device connected to an electrically-propelled vehicle on the railway extending into the conduit, and bearing on the vertical face of the conductor.

14. The combination, in a series electric railway, of a main sectional conductor inclosed in a conduit and having a series of horizontally-movable switches between the sections, and a contact device connected to an electrically-propelled vehicle on the railway extending into the conduit, and bearing on a vertical face of the conductor.

15. The combination, in a series electric railway, of a series of switches normally maintaining the electrical connection between the sections of the main conductor, a slotted inclosure for the said switches, an operating device therefor having a shank extending through the slot of the inclosure, and a projection or enlargement upon said shank at right angles

thereto within the inclosure, by which the switches are operated.

16. The combination, in a series electric railway, of a sectional conductor, a positive switch between the sections adapted to remain in either an open or closed position, an electrically-propelled vehicle, and an independent opening and closing device upon each end of said vehicle, adapted to positively actuate the switches when proceeding in either direction.

17. The combination, in a series electric railway, of a sectional main conductor, inclosed positive switches between the sections adapted to remain in either open or closed position when once actuated, an electrically-propelled vehicle, and a pair of opening and closing devices for said switches connected with said vehicle, but within the inclosure, so as to positively actuate the switches when proceeding in either direction.

18. In a series electric railway, the combination of a main sectional conductor having a series of switch-connections between the sections, a slotted conduit inclosing the same, an electrically-propelled vehicle upon the railway, and two contact devices movable laterally with respect to the vehicle, connecting with opposite terminals of the propelling-motor, and extending into the conduit from points of the vehicle outside of the wheel-base, whereby conductor-sections longer than said wheel-base may be employed.

19. In a series electric railway, the combination of a series of switches normally maintaining the electrical connection between the sections of the main conductor, a slotted conduit inclosing the same, an electrically-propelled vehicle, and two actuating devices for said switches extending into the conduit connected with said vehicle, but movable laterally relatively thereto, and separated a distance apart greater than the wheel-base thereof.

20. The combination, in an electric railway, of an electric switch, a slotted conduit inclosing the same, an actuating device therefor supported from a vehicle outside the conduit and consisting of a shank extending through the slot of the conduit, and a collapsible operating device on its lower end adapted to be withdrawn through the slot.

21. The combination, in a branching electric railway having an inclosed supply-conductor, of a branching slotted conduit therefor, with a movable slot-guide and a movable conductor-guide having their free ends extending toward each other.

22. The combination, in a branching electric railway, of a single sectional supply-conductor on the main line, a corresponding conductor on the branch line, two contact devices adapted to either conductor, connected to the two terminals of a propelling-motor on the railway, and always bearing on the conductor on opposite sides of a break therein, and a movable conductor-guide at the branching point for leading the two contacts from main to branch conductor.

23. The combination, in a branching electric railway, of a sectional conductor on the main line having mechanically-operated switches between the sections, a corresponding sectional conductor on each branch road with contacts having constant connection with the conductor upon opposite sides of a break therein, and an electrical connection between the end of one branch conductor and the beginning of the other branch, whereby the motors on the two branches may be in series.

24. The combination, in a branching electric railway, of a sectional electric conductor on the main line and contacts connected with opposite terminals of a motor on the road, separated a distance equal at least to that of a section of conductor, and bearing on said conductor upon opposite sides of a break therein, a corresponding sectional conductor on the branch railways, and a movable conductor-guide at the branching point, with a free end movable from one to the other of the conductors on the branches.

25. The combination, in a series electric railway, of a sectional main conductor, a series of switches in a slotted inclosure normally connecting the sections, an electrically-propelled vehicle having a wheel-base shorter than the length of the sections, and actuating devices for the said switches having a range equal at least to the length of a section, so that two switches may be open at the same time and connected to the vehicle so as to have a transverse movement relative thereto, whereby a length of section longer than the wheel-base may be employed.

26. The combination, in a series electric railway, of a sectional main conductor having its bare contact-surfaces in a slotted inclosure, an electrically-propelled vehicle having a wheel-base shorter than the length of the sections, and two contact-conductors connected to the terminals of the propelling-motor, extending into the inclosure so as to embrace between their extremities a longitudinal distance equal at least to the length of a section, and connected to the said vehicle so as to have a lateral movement relative to the vehicle, whereby a section longer than the wheel-base may be employed.

EDWARD M. BENTLEY.

Witnesses:
EDWARD STEER,
HARRY E. KNIGHT.