(No Model.)

J. SCHNEPF.

CLOSED CONDUIT ELECTRIC RAILWAY.

No. 532,590. Patented Jan. 15, 1895.

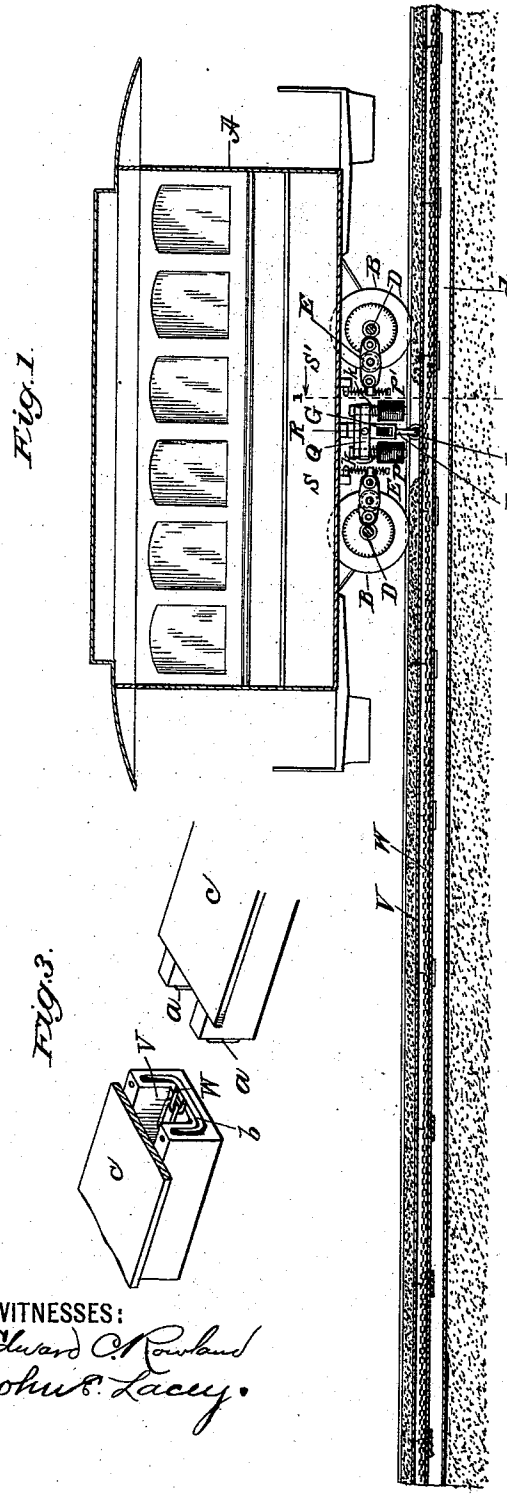

Fig. 1.

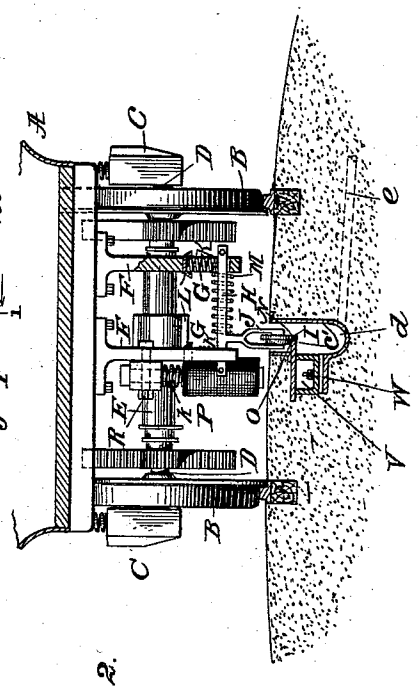

Fig. 2.

Fig. 3.

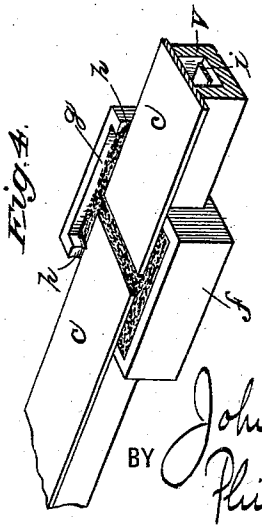

Fig. 4.

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JOHN SCHNEPF, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO WILLIAM H. BELLAMY AND WILLIAM C. DOSCHER, OF SAME PLACE.

CLOSED-CONDUIT ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 532,590, dated January 15, 1895.

Application filed September 9, 1893. Serial No. 485,176. (No model.)

To all whom it may concern:

Be it known that I, JOHN SCHNEPF, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric Railways and their Method of Operation, of which the following is a specification.

My invention relates to improvements in the construction of electric railways and their method of operation; it being applicable also to use in other electrical apparatus, structures or systems in which the current is conveyed to a movable motor by means of a conductor.

Heretofore, various attempts have been made to devise a system of electric transportation in such manner that the conductor (ordinarily called the "trolley wire") shall be underground; so that the many well-known objections to the "overhead" system may be avoided; but so far as I am informed, none of them have been sufficiently successful to come into general use. Their defects have been attributed to a variety of causes which need not be recited here. By my invention, I remove most, if not all of such objections, and I have produced, as I believe, a practical and efficient system.

Generally stated, my invention consists in placing the conductor underground in a suitable conduit, where it is free from contact with anything which can either injure it or which can be injured by it—and immediately over the conductor, I place, insulated or partially insulated metallic plates, which are constructed and arranged so as to conduct the current to the trolley, which, being attached to the car, runs in contact with the plates and from the trolley wheel the current is conducted to the motor in any well-known manner, there being one or more magnets carried by the car, which attract the conductor, as the car passes over it, and lift it into contact with that one of said plates, which is immediately under the car, and they are made of such length that neither end projects beyond the ends of the car and they preferably are not longer than the distance between the axles of the car, or, if it be a two truck car, not longer than the distance between the centers of the two trucks. Consequently, these plates being, as stated, insulated from each other, and preferably from the ground or road bed also, the current cannot leave them, except to pass to the trolley wheel and from it to the motor to actuate it.

I construct my system in two ways. The one preferred by me is that in which the plates above referred to are protected by a superposed layer of cement, concrete, or similar material, which forms a part of the road bed, being placed on top of them the trolley wheel or equivalent device projecting downwardly through a slot made in the road bed to engage with the said plates. When this form is used, the plates may be made of iron, steel or any other preferred metal, magnetic or non-magnetic.

The other form in which I sometimes construct my system, is that in which the plates appear upon the surface of the road bed. In this form, the said plates should not be made of magnetic metal, because if they are, there is danger that the residual magnetism retained by the plates after the passage of the magnets over them may be sufficient to permanently hold the conductor in contact with them, or at least sufficiently long to allow the car to pass from over them, when they would at once become exceedingly injurious to horses and people in the street. Consequently, when the said plates are not protected by a superposed non-conducting or insulating material, they should be made of non-magnetic metal. I also prefer that the conductor should be made in the form of a chain or at least, link-like in construction, because, if so made, no power is required to flex the conductor, and also it automatically compensates for expansion and contraction, whereas conductors in the form of a wire, ribbon or cable, require power to flex them, and they are all influenced by heat and cold—that is to say, it has been known to happen that a cable, ribbon or wire conductor will expand so much in hot summer weather, or when brought in contact with heating pipes, as that they will buckle or hump, and it might do so to such an extent as to make permanent contact with one or more of the surface plates, and if this should take place, such plate or plates would be a per-

manent menace to life in the streets. Also in cold weather, it has been known that the contraction of such a conductor will cause it to be stretched so tight, that the magnets will not have the requisite operative power to lift them into contact with the plates. Also the passage of the current through a conductor affects its length materially, and under many circumstances would tend to twist, buckle or otherwise interfere with the proper operation of my system. Consequently, as above stated, I greatly prefer the chain form of conductor. I, however, illustrate in one of the drawings in this application, a conductor in the form of a ribbon, because I do not, excepting as hereinafter specified and claimed, restrict myself to a chain conductor.

In the drawings hereof, I show the invention as applied to a street car. It will be understood, however, that it is applicable also to any analogous use, the one illustrated being an example only.

Figure 1, illustrates an elevation partly in section, of the invention. Fig. 2, illustrates a vertical section on the line 1, 1, of Fig. 1, looking in the direction of the arrow. Fig. 3, illustrates a detail of one form of conduit within which the conductor is inclosed. Fig. 4, illustrates an alternative construction of the conduit.

A illustrates the car; B, B, the wheels; C, C, the journals; D, D, the axles; E, E, the motors. All the above parts may be of any preferred construction.

F, F are two hangers which are bolted to the under side of the car as shown. They are slotted near their lower ends, as at G, G, and in the slot rises and falls a bar H, which is squared to correspond with the slots, G, G in the hangers. A trolley wheel, I, revolves in a bifurcated arm, J, depending from the bar H.

K, K are two springs, which are placed in the slots in the hangers, and at their lower ends, they rest upon the ends of the bar H, and at their upper ends, they are held within inverted dish-shaped parts, L, L, made at the upper ends of the slots in the hangers. The bar H is normally held down at the lower ends of the slots by these springs.

M is another spring which encircles the bar H, and normally crowds it, and the trolley wheel arm J, which carries the trolley wheel to the left.

The edge of the trolley wheel is flanged at N and has a tread O.

P, P′ are two electro magnets. They are supported upon a cross-head Q, which is pivoted at R to any suitable support on the car, and they are immediately supported by two downwardly extending spindles S, S′, which pass through the coils of the magnets and have nuts on their ends. These spindles pass upwardly through the cross-head Q, and are adapted to slide through it and there are springs *k*, *k* which engage with the upper ends of the magnets at one end and against the cross head at the other. Consequently, if the foremost magnet (depending, of course, upon the direction in which the car is moving) comes in contact with any obstruction, such as a cobble-stone, or the like, both of the magnets will rock upon the pivot R, the cross-head Q changing its position, and when the obstruction comes in contact with the rear-most magnet, the cross-head will rock in the other direction. In this way, the magnets can, so to speak, rock themselves over an obstruction without suffering harm, and if the obstruction be so large that the rocking of the cross-head will not be sufficient, then the magnets may bodily rise by reason of the compression of the springs *k*, which will permit the spindles to slide upwardly through the cross-head, thus lifting the magnets in addition to the rocking motion above described, and after the obstruction has been passed, the parts will all return to their normal condition.

V, (see Figs. 1, 2 and 3) is the conduit which contains the conductor W, which in this instance is a chain. The conduit is made of any suitable material, but must be lined with insulating material, if not in and of itself, an insulator.

I have found that a stick of timber, hollowed out as shown in Fig. 3, and treated with creosote or tar, to prevent absorption of water, makes a reasonably good conduit. To secure water-tightness at the ends, I prepare a tongue, *a* and groove *b*, on the adjoining ends of the timber sections, which are fitted into each other when the conduit is laid, and the joint is then made tight by tar or equivalent material, and the entire conduit is preferably laid in and covered by a bed of cement or concrete, including the conducting plates *c*, which rest on the upper edges of the conduit, and are suitably fastened to it. They are not insulated on their under sides, but make metal contact with the conductor. The plates *c* are preferably from four to eight or ten feet long and their ends are separated from each other a sufficient distance to prevent the current from passing from one to the other and insulating material may be placed between their ends if desired. They should, not however, be separated by so great a distance but that the trolley wheel will always be in contact with one or the other of them. Ordinarily, a separation of an inch or less will be sufficient.

The conduit is laid in the street as before stated, under the ground or pavement, and preferably in a bed of cement or concrete, which is also laid over the plates *c* as shown in Fig. 1, and there is an iron or other frame *d*, which if metal, is insulated from the plates *c*. This frame is in effect a deep, narrow trough, which runs the length of the street, and into one side of it, one edge of the plates *c* projects, somewhat as seen at *c′*, Fig. 1, and the trough extends below the conduit, as shown, or at least sufficiently below the projecting edges *c′* of the plates, to afford an ice and snow depository, and a drain to convey

away such water as may get into the groove. At frequent intervals, it is provided with leaders *e*, which convey the water and other materials which collect in the groove, into the sewer or other outlet. As above stated, these plates *c*, when covered with the cement, concrete or other non-conducting material, as shown in Figs. 1 and 2, may be made of any preferred metal, whether magnetic or not, because these plates as stated are insulated from the metal of the trough, if it be made of metal, and no part of them is accessible from the surface of the street, excepting by means of the slot down through which the trolley device extends, and this is so narrow that no part of a horse or pedestrian or carriage wheel could pass through it. If, however, the construction be such that these plates are accessible from the surface of the street, in other words, exposed, then they should be made of non-magnetic metal, so that no accident can occur by reason of the residual magnetism holding the conductor in contact with them, if such thing should happen.

The operation is as follows: The cars when run out of the car house, first pass over one of the plates *c*, with which the conductor W has permanent contact. This particular plate should be protected or inclosed in some suitable manner, so that accidents cannot occur by reason of people or animals stepping on it or otherwise coming in contact with it. The moment the trolley wheel comes in contact with the edge of this first plate, it receives the current which is in the plate derived from the conductor as stated. A portion of the current passes from the trolley to the electro magnets, by suitable connections (not shown) and the balance passes to the motor in any of the known methods. The motor is of course controlled by a suitable switch. The car being set in motion, moves forward from one plate to the next, and so on in succession, and the magnets are made of such power, that they attract the conductor W as they move with the car, and lift it against the under side of the plates, each in succession, and after the car has passed each plate, the conductor drops again into the bottom of the conduit. Thus the electro magnets and the motor are continually supplied with current.

It will be noticed that the magnets being supported on a pivot R and provided with the springs *k*, *k*, are movable and will oscillate and rise to avoid any obstruction in the road or street, and also that the springs K, K, permit the bar H, which supports the trolley wheel to rise should it strike any obstruction, thus avoiding fracture of the parts, and also that the spring M, presses the flange of the trolley wheel snugly against the edge of the several plates. Thus, those edges and the flange of the wheel, are always kept clean and bright, and good contact secured; also, if the conductor be in the form of a chain which form, as above stated, I very greatly prefer, the movement of the links upon one another, secure bright, clean surfaces, and the impact of the links against the under side of the plates, as the chain is snapped up against them by the magnets, secures always good contact at that point. Any other form of conductor, however, may be employed, such as a wire cable or a ribbon of metal. I prefer, however an iron chain, copper plated. The copper plating of the chain may, in some instances be omitted and any suitable metal or alloy of metals may be substituted for the copper as a plating for the chain, if a plating be used.

It will be obvious to those who are familiar with this art, that a shoe or plate may be substituted for the revolving trolley wheel, it being so arranged that it will be pressed against the plate during its movement; also that permanent magnets may be substituted for the electro magnets shown, and that means for energizing the electro magnets, other than the divisional current from the trolley may be employed, if preferred.

In Fig. 4, I show another method of connecting the ends of the conduit. At the ends of the several lengths of the conduit, I provide a box, *f*, into which the said ends enter and are firmly spiked in place. Then cement or concrete is laid all about the ends within the box, as shown at *g*. A notch or channel *h* must be left in the sides of the box, for the passage of the trolley wheel or plate, adjacent to the edges of the plates *c*. In Fig. 4, I show the conductor in the form of a ribbon at *i*.

I do not limit myself to the details of construction shown and described, because many modifications may be made therein and still the essentials of my invention be employed.

I claim—

1. The combination of a slotted conduit and adjacent thereto a conduit containing a continuous, flexible and movable main conductor, metallic plates over the latter conduit, insulated from each other longitudinally, and also insulated from the surface of the street by superposed non-conducting material and which project into the slotted conduit, a trolley which engages with the said plates and a magnet and a motor on the car, whereby the magnet may draw the main conductor into direct contact with said metallic plates, substantially as set forth.

2. The combination of a slotted conduit and adjacent thereto an insulated conduit containing a continuous, flexible, movable, main conductor, metallic plates which cover the latter conduit and which are insulated from it and from each other, and which are also insulated from the surface of the street by superposed non-conducting material and which project into the slotted conduit, a trolley, which engages with said plates and a magnet and a motor on the car whereby the magnet

may draw the main conductor into direct contact with said metallic plates, substantially as set forth.

3. The combination of a conduit containing a continuous, flexible, movable main conductor, metallic plates made of non-magnetic material, over the conduit, which are insulated from each other longitudinally, a trolley which engages with said plates, and a magnet and a motor on the car whereby the magnet may draw the main conductor into direct contact with said non-magnetic plates, substantially as set forth.

4. The combination of a conduit, a continuous, flexible, movable main conductor made in the form of a chain or of interlocking links placed within the conduit, metallic plates on the conduit which are insulated from each other longitudinally, a trolley which engages with said plates and a magnet and a motor on the car, whereby said main conductor may be drawn by the magnet into direct contact with said plates, substantially as set forth.

5. The combination of a slotted conduit and adjacent thereto a conduit containing a continuous main conductor in the form of a chain or having interlocking links, metallic plates on the latter conduit, which are insulated from it and from each other and from the street by superposed non-conducting material and which project into the slotted conduit, a trolley which engages with said plates, and a magnet and a motor on the car, whereby said main conductor may be drawn by the magnet into direct contact with said plates, substantially as set forth.

6. The combination in an underground trolley system of a continuous main conductor composed of interlocking links and plates upon the conduit against which the said conductor is adapted to be drawn magnetically, substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 6th day of September, A. D. 1893.

JOHN SCHNEPF.

Witnesses:
PHILLIPS ABBOTT,
E. SIMPSON.