No. 749,401. PATENTED JAN. 12, 1904.

L. W. PULLEN.

ELECTRIC RAILWAY.

APPLICATION FILED APR. 18, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

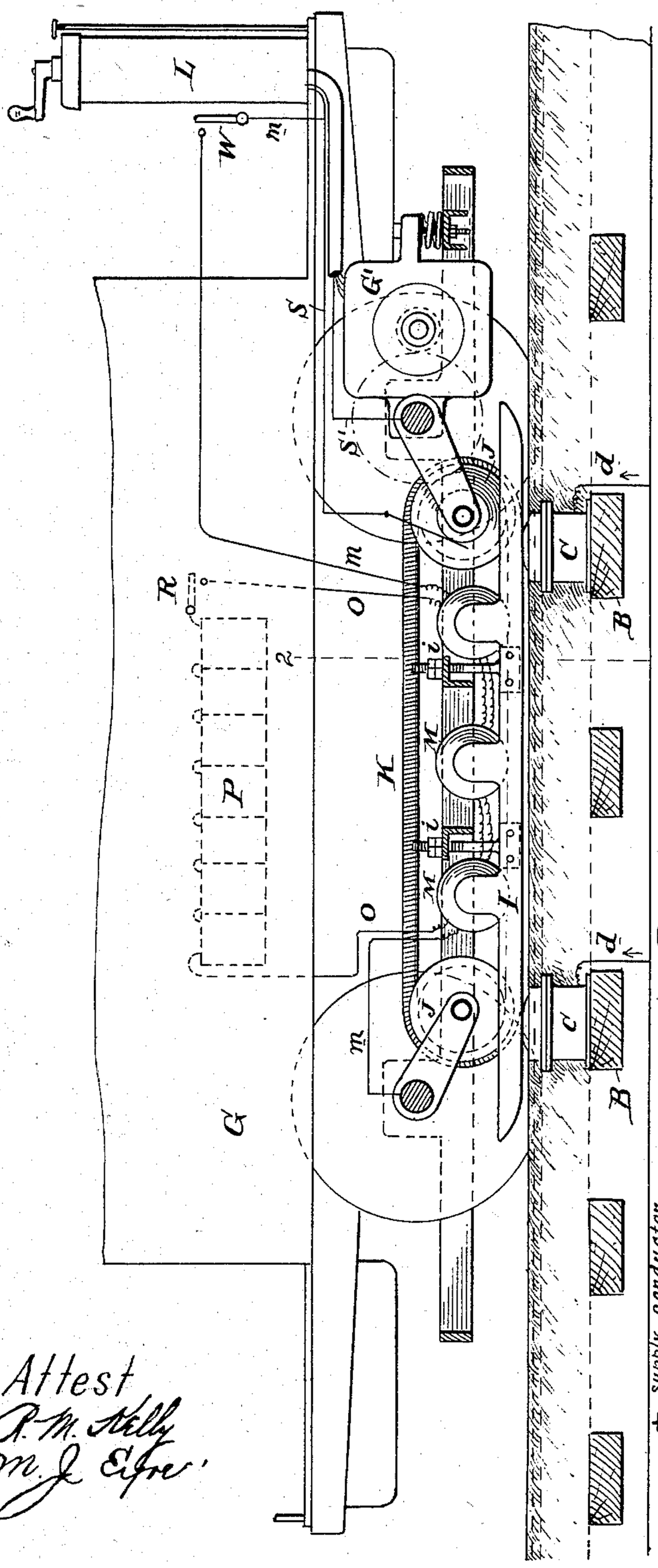

FIG. 1

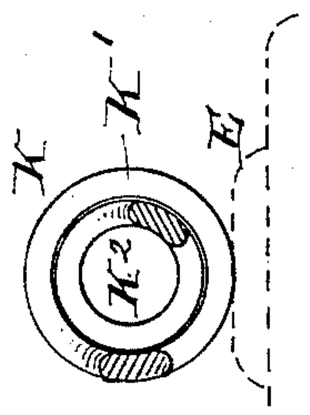

FIG. 5

Attest
P. M. Kelly
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By his atty
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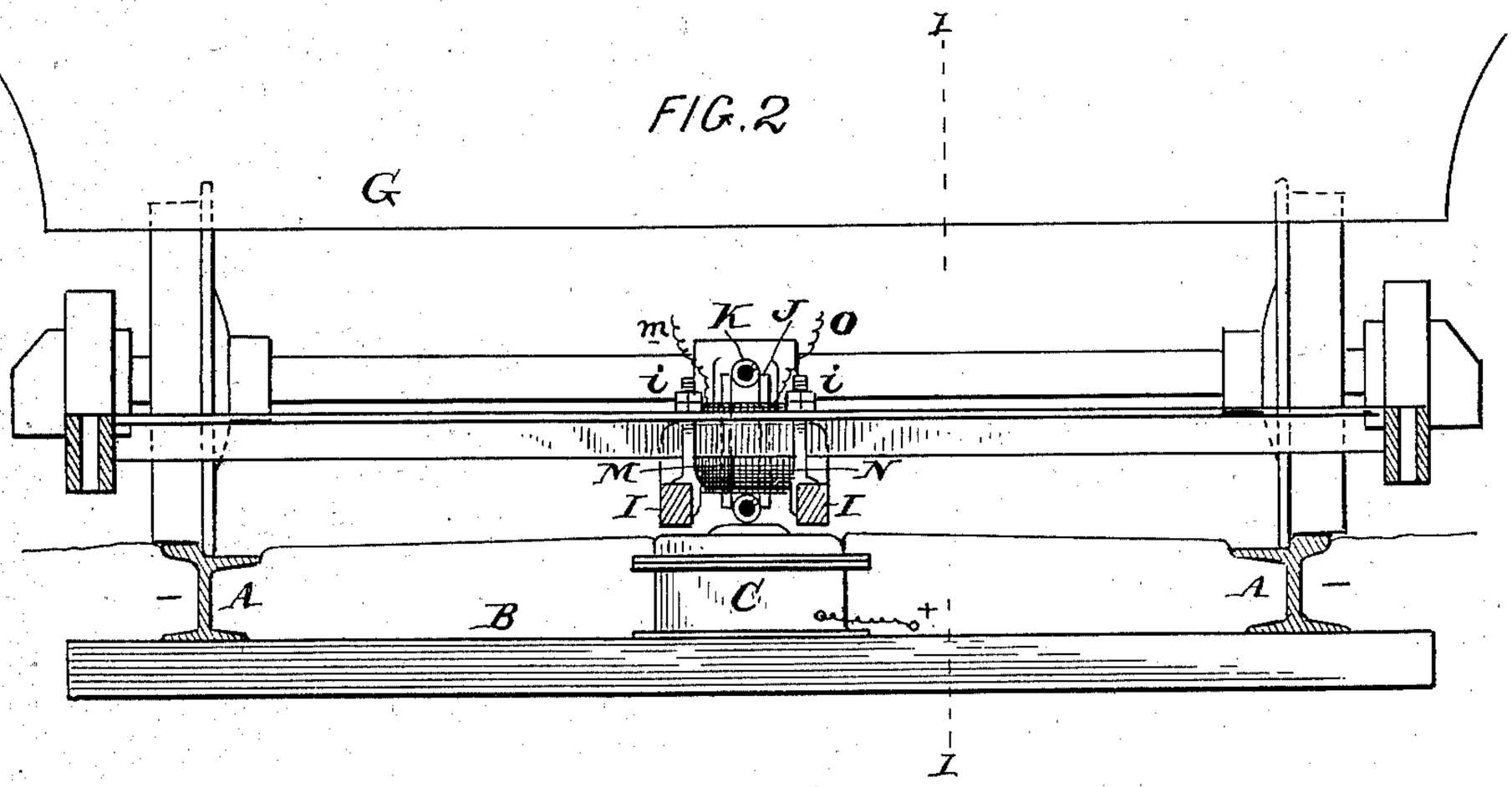
NO MODEL. 2 SHEETS—SHEET 2.

FIG. 2



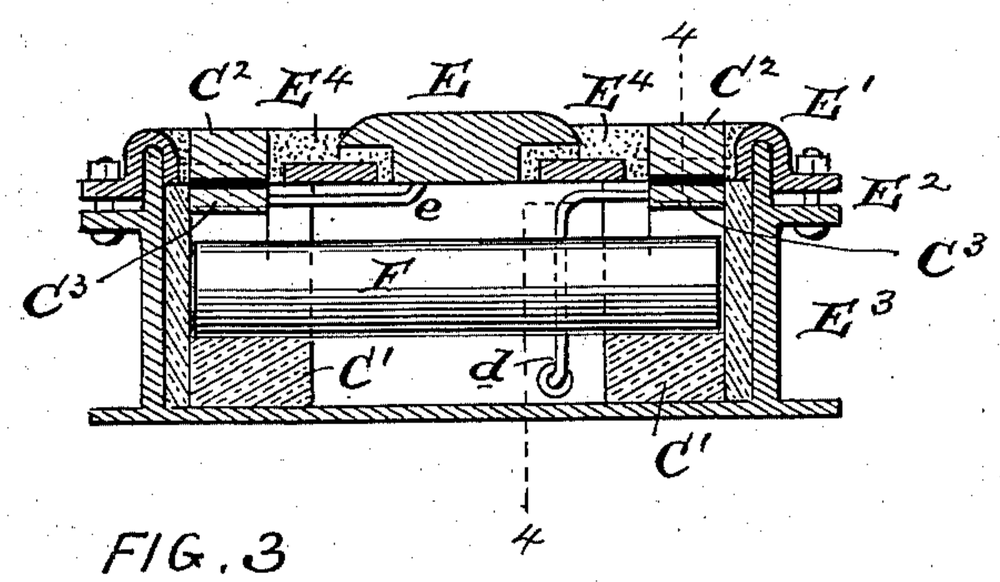


FIG. 3

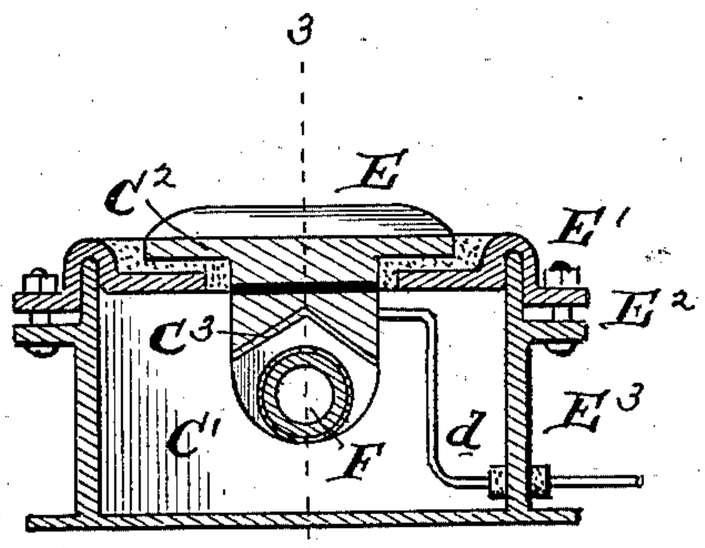


FIG. 4

Attest
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No. 749,401. Patented January 12, 1904.

UNITED STATES PATENT OFFICE.

LEON W. PULLEN, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO WIRELESS RAILWAY COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF DISTRICT OF COLUMBIA.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 749,401, dated January 12, 1904.

Application filed April 18, 1903. Serial No. 153,155. (No model.)

To all whom it may concern.

Be it known that I, LEON W. PULLEN, of the city and county of Philadelphia, State of Pennsylvania, have invented an Improvement in Electric Railways, of which the following is a specification.

My invention has reference to electric railways; and it consists of certain improvements, which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

The object of my invention is to provide means adapted to existing railways for operating an electrically-propelled car and whereby the circuit for supplying current to the car is only completed at points adjacent to the car as it travels over the working or supply conductors or contact-blocks. In this manner the supply-conductor may be inclosed or protected beneath the road-bed and contact-blocks upon the surface put into electric circuit with the said supply-conductor only when and during the time the car is passing them and the supply of current to the motor on the car received from said contact-blocks when in closed circuits.

In carrying out my invention I provide the road-bed with a series of specially-constructed electromagnetic switches adapted to be energized by magnets or pole-pieces upon the car whereby they will close automatically for a period corresponding to the time the car is over them. These switches control a series of branch circuits receiving current from a supply-circuit and supply it to contact-blocks upon the surface of the track. I provide the car with one or more electric motors to propel it and magnets for operating the electromagnetic switches, whereby said switches may be automatically energized and caused to close and open the circuits in succession as the car passes them and make electric contact with the contact-blocks arranged along the railway. The car is further provided with a long traveling contact-shoe or collector adapted to make contact with the contact-blocks along the track and has capacity for adjustment relative thereto, the length of said shoe being somewhat greater than the distance between two successive contact-blocks, so as to at all times make electric circuit with one block before breaking contact with another.

My invention also comprehends details of construction which, together with the above features, will be better understood by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal elevation of an electric railway and car with part in section embodying my invention. Fig. 2 is a cross-section of same on line 2 2. Fig. 3 is an enlarged sectional end view of one of the magnetic switches. Fig. 4 is a front view of same with part broken away, and Fig. 5 is a cross-section of the traveling contact-shoes.

A represents the rails, which may, if desired, constitute the return-circuit. B represents the cross-ties, and C represents a series of electromagnetic switches arranged along the railway-track and carried by the cross-ties. These switches consist of two upright slotted frames C' C', of insulating material and loosely supporting a tubular armature F, of iron, which has capacity of being raised in the slotted frames. Secured above these frames C' are arranged contact-caps C^2 C^2, the lower or contact portions C^3 within the slots of the frames C' being made recessed or inverted-**V**-shaped to present a more extended surface for contact with the tubular armature. These contact-caps or those portions thereof constituting the contact parts C^3 are preferably made of iron and faced with copper to insure a more perfect contact. The contact parts C^3 of the contact-caps are insulated from the upper or exposed portions, as it is evident that while the magnetic influence shall be exerted through the parts C^2 C^3 to the armature the current delivered to the parts C^3 should not be permitted to reach parts C^2. An inclosing box or case of non-magnetic material properly insulated incloses the parts above described and extends to the surface of the road-bed. As shown, these cases consist of a base part E^3, supporting the upright parts C', and a cover E', bolted thereto at E^2 to make a water-tight joint.

E is a contact-block of metal secured to and insulated from the cover E′ of the box and having a connection *e* with one of the contact-caps C^2. Asphaltum or other insulating material may be employed over the cover upon each side of the contact-block E. The contact-caps C^2 may be carried by the cover E′ and either or both be insulated from said cover to prevent short-circuiting thereby. The other contacts C^3 of the contact-caps C^2 of each of the switches are connected by a branch circuit *d* with the supply-conductor D, which may be insulated and embedded in the road-bed or otherwise extended along the railway. The asphaltum or concrete of the road-bed is preferably slanted from the center down to the rails with a slight grade, so as to cause the water to drain away from the contact-blocks located centrally between the rails of the track.

The car G is provided with any suitable electric-motor equipment G′ for propelling it, which may be controlled by a controller L of any form or type. The current is delivered from the collector under the car by circuit S to the controller L and then to the motor and finally to the rail return through the axles. The collector consists of two wheels J J, journaled to rotate on horizontal axes arranged at a distance apart and about which an endless metal collecting-band K travels. As shown, this band may consist of an endless coil-spring K^2, surrounded with a coil wearing or contact surface K′, which can be replaced when worn. Any other form of collector may be employed, if so desired, and it is evident that it need not be of endless character where mere sliding frictional contact alone is required. The length of this collector K is somewhat greater than the distance between two contact-switches C C, so that it is in contact with the contact-block of one switch before breaking connection with the next one in the rear. Arranged adjacent to the collector and upon each side thereof is a pole-bar I, which bars, respectively, travel over the contact-caps C^2 C^2, so as to magnetize them and the armatures F while the car is passing above the switch-boxes for causing the said armatures F to rise and form an electric connection between the two contacts of the contact-caps. In this way the current is led from the supply-conductor D through wires *d*, thence through the armatures and contacts of the contact-caps to the contact-blocks E, from which it is delivered to the collector K and thence to the motor. The pole-bars are connected together by transverse portions and so as to constitute an inverted-**V**-shaped structure, which may be permanently magnetized. Surrounding the horizontal portions of this magnetic structure I prefer to arrange two sets of coils M and N, the former being designed to produce a strong electromagnetization of the pole-bars when the car is in operation and the latter to produce a temporary magnetization for the purpose of initially causing the pole-bars to lift the armatures F when it is desired to put the car into operative condition. The coils M are in a circuit *m*, connected at one end with the axle or frame of the car and at the other end with the collector, and may have a switch W contained therein for opening this circuit when required, such as might exist in case it was necessary for the operator to get under the car for any purpose and when it would be advisable to shut off the current from the contact-blocks E. The coils N are in circuit O, containing a secondary or other battery P and a switch R, so that when it is desired to start the car upon leaving the station or after the switch W had been opened, as above explained, the current from the battery may be supplied to the coils N, and thus magnetize the pole-bars I sufficiently to cause them to pick up the armatures F. This action is only momentary if the switch W is closed, as then the coils M continue the magnetization. In practice the coils M would be of high resistance and the coils N of low resistance to suit the difference in the voltage of the railway-current and the battery-current. In case the magnet structure is to be a permanent magnet of great strength then it is possible to dispense with the coils M and N; but I prefer to use them. It is also evident that when the coils are employed it would not be necessary to have the bars I permanently magnetized, though they are preferably made so. The pole-bars are preferably adjustable vertically for adjustment relatively to the switches, and this may be secured by means of the devices *i*, consisting of screws and nuts, supporting the pole-bars or magnets. It is advisable that the pole-bars I be made longer than the operative length of the collector-band K, so that the armatures F shall be brought into closed circuit with the contact-cap C^2 before the collector K reaches its contact-block E and shall also hold up the armature in the switch to the rear until after the collector K has left the contact-block of said switch. In this way the switches are out of electric circuit at the moment the armatures are lifted, thereby preventing any arcing or burning out of the switches. These switches C are in operation two-pole switches, since they have two air-gaps—one between each of the contacts C^3 and the armature F. This will allow of shorter lifting distance for the armature, and hence a lower strength of magnet to lift them than would otherwise be necessary.

In the operation of this system the contact-blocks E are only in circuit when under the influence of the pole-bars, so that at all other parts of the railway there is no possibility of danger from exposed "live" circuits.

The magnet-bars I I constitute north and south poles, and these acting through the con-

tact-caps C^2 strongly magnetize the armature F, which being of tubular iron and sheathed with copper at its ends is light and easily lifted. It is to be understood that while the contact portions C^3 of contact-caps C^2 are preferably of iron they need not be so; but in such case the magnetic strength of the pole-bars would have to be greater. These pole-bars are not allowed to touch the switch-boxes, but are preferably adjusted as close to them as is practical in the commercial operation of the apparatus.

While I prefer the construction herein set out, I do not confine myself to the details thereof, as they may be modified without departing from the spirit of the invention.

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

1. In an electric railway, the combination of a series of magnetic switches arranged along the railway and each having a loose gravity-actuated magnetic armature placed transversely to the length of the track and two contact-caps having contacts to constitute a two-pole switch, a supply-circuit having branch conductors controlled by the series of switches for supplying current to exposed portions on the surface of the railway, an electrically-propelled car having a collecting device for receiving current from the exposed portions of the branch circuits when the switches are closed, and a magnet having north and south poles arranged parallel to each other and extending in the direction of the length of the car and respectively above the two contact-caps of the magnetic switches, and means for vertically adjusting the magnet structure to and from the road-bed and contact-caps.

2. In an electric railway, the combination of a series of magnetic switches arranged along the railway and each having a loose gravity-actuated magnetic armature placed transversely to the length of the track and two contact-caps having contacts to constititute a two-pole switch, a supply-circuit having branch conductors controlled by the series of switches for supplying current to exposed portions on the surface of the railway, an electrically-propelled car having a collecting device for receiving current from the exposed portions of the branch circuits when the switches are closed, and a magnet having north and south poles arranged parallel to each other and extending in the direction of the length of the car and respectively above the two contact-caps of the magnetic switches.

3. In an electric railway, the combination of a series of magnetic switches arranged along the railway and each having a tubular armature of magnetic material placed transversely to the length of the track and two magnetic contact-caps having contacts to constitute a two-pole switch, a supply-circuit having branch conductors controlled by the series of switches for supplying current to exposed portions on the surface of the railway, an electrically-propelled car having a collecting device for receiving current from the exposed portions of the branch circuits when the switches are closed, a magnet having north and south poles arranged parallel to each other and extending in the direction of the length of the car and respectively above the two contact-caps of the magnetic switches, one or more magnetic coils upon the magnet between the poles, and an energizing-circuit including the coils.

4. In an electric railway, the combination of a series of magnetic switches arranged along the railway and each having a tubular armature of magnetic material placed transversely to the length of the track and two magnetic contact-caps having contacts to constitute a two-pole switch, a supply-circuit having branch conductors controlled by the series of switches for supplying current to exposed portions on the surface of the railway, an electrically-propelled car having a collecting device for receiving current from the exposed portions of the branch circuits when the switches are closed, a magnet having north and south poles arranged parallel to each other and extending in the direction of the length of the car and respectively above the two contact-caps of the magnetic switches, one or more magnetic coils upon the magnet between the poles, an energizing-circuit including the coils, and independent energizing means for the magnet carried by the car and under the control of the operator for energizing the magnet when the magnetic switches are open.

5. In an electric railway, a series of magnetic switches arranged along the road-bed for supplying current to the motor consisting of an inclosed case, combined with two magnetic contact-caps in the upper part of the case and having contacts insulated therefrom, a contact-block arranged above and insulated from the case and electrically connected with one of the contacts of the contact-caps, an electric circuit supplying current to the contact of the other contact-cap, a transverse magnetic armature arranged below the two caps and adapted to be raised under magnetic attraction, and insulating-supports for the armature for holding it close to the contact-caps with freedom of upward movement.

6. In an electric railway, a series of magnetic switches arranged along the road-bed for supplying current to the motor consisting of an inclosed case, combined with two contact-caps having contacts arranged in the upper part of the case and insulated therefrom and in which said contact-caps are made of magnetic material, a contact-block arranged above and insulated from the case and electrically connected with the contact of one of the contact-

caps, an electric circuit supplying current to the contact of the other contact-cap, a transverse armature arranged below the two caps and adapted to be raised under magnetic attraction, and insulating-supports for the armature for holding it close to the contact-caps with freedom of upward movement.

7. In an electric railway, a series of magnetic switches arranged along the road-bed for supplying current to the motor consisting of an inclosed case, combined with two contact-caps in the upper part of the case and insulated therefrom and each having a contact part presenting more than one point of contact for the armature, a contact-block arranged above and insulated from the case and electrically connected with one of the contact-caps, an electric circuit supplying current to the other contact-cap, a transverse tubular armature arranged below the two caps and adapted to be raised under magnetic attraction, and insulating-supports for the armature for holding it close to the contact-caps with freedom of upward movement.

8. In an electric railway, the combination of a series of contact-blocks arranged along the surface of the railway, two magnetic contact-caps having contacts of magnetic material faced with copper, a transverse tubular armature of magnetic material faced with copper, a supply-conductor extending along the railway, branch conductors leading from the supply-conductor to one set of contacts of the contact-caps of each switch structure, conductors connecting the other contacts of the contact-caps respectively with the series of contact-blocks, and insulating-supports for the armature, contact-blocks and contact-caps.

In testimony of which invention I hereunto set my hand.

LEON W. PULLEN.

Witnesses:
R. M. HUNTER,
R. M. KELLY.