

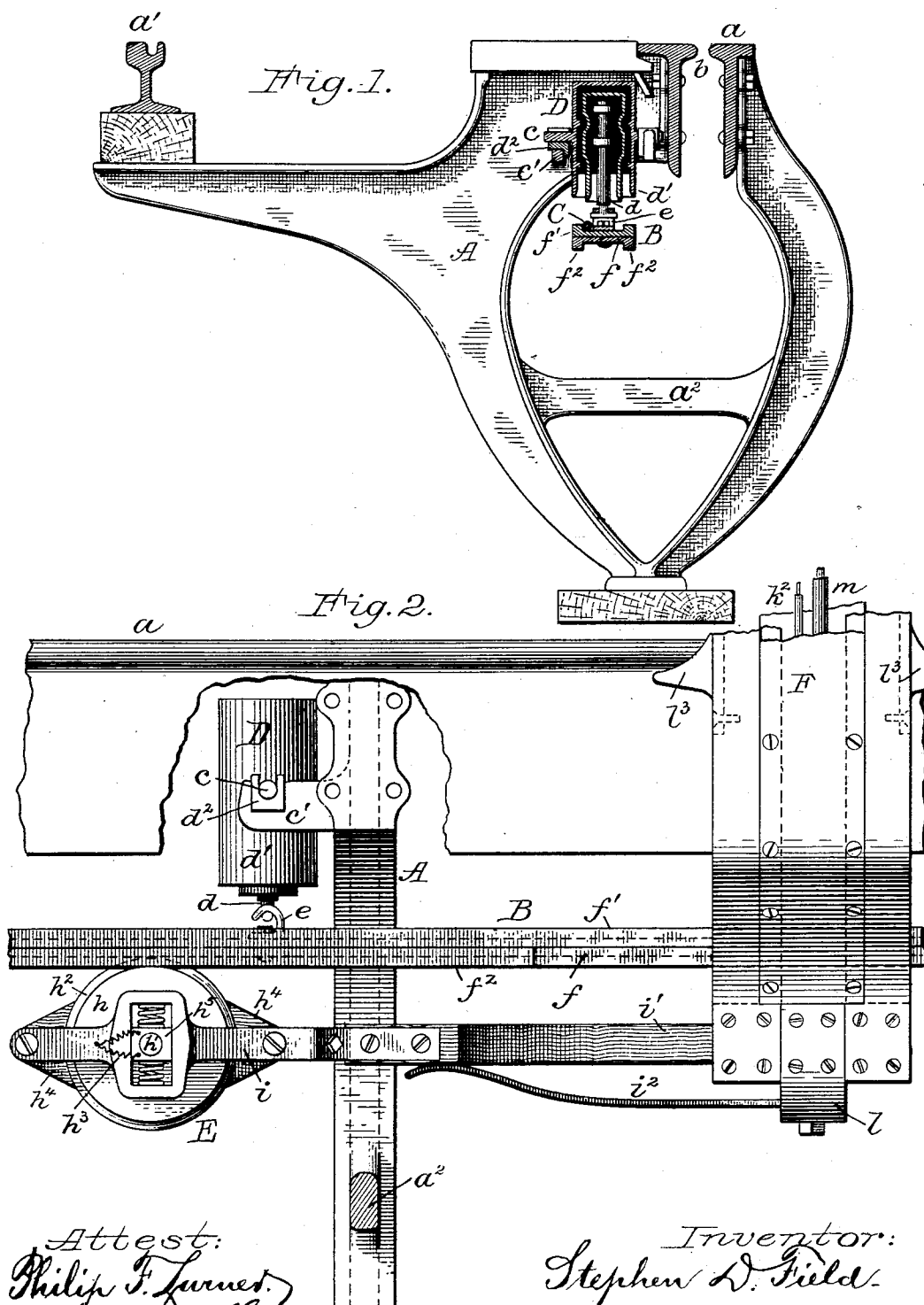
(No Model.)

3 Sheets—Sheet 1.

S. D. FIELD.
ELECTRIC RAILWAY SYSTEM.

No. 587,720.

Patented Aug. 10, 1897.



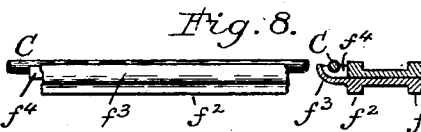
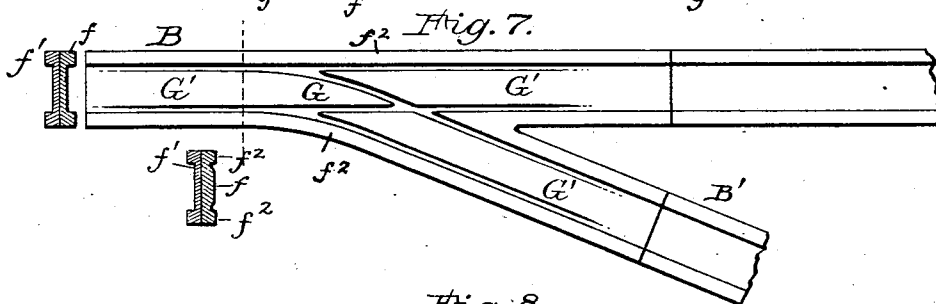
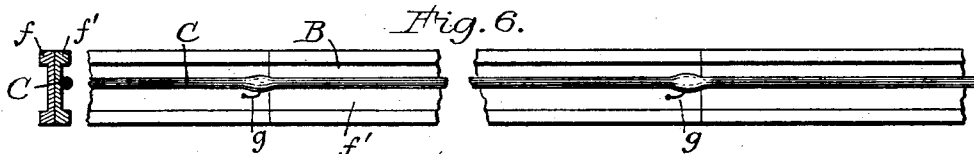
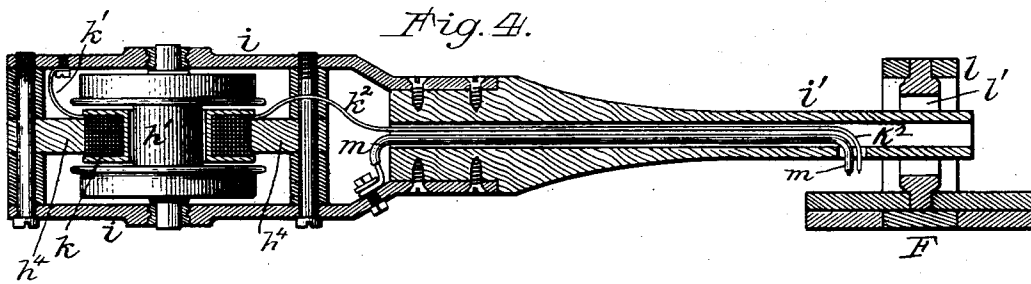
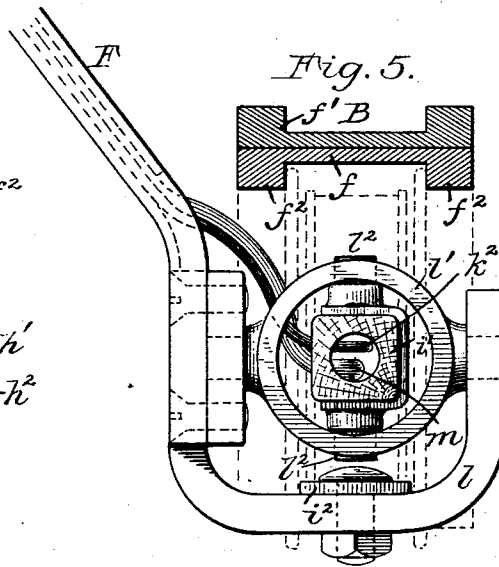
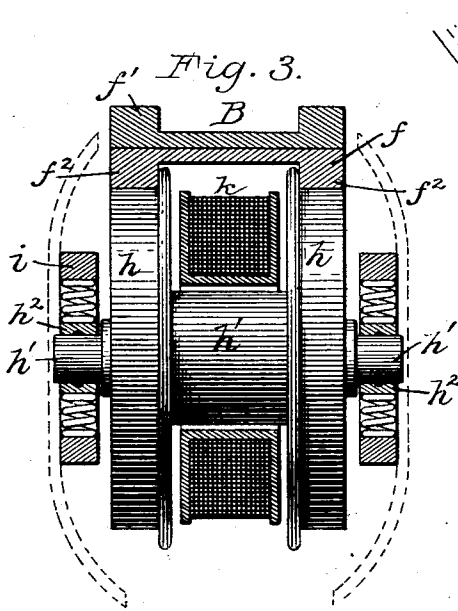
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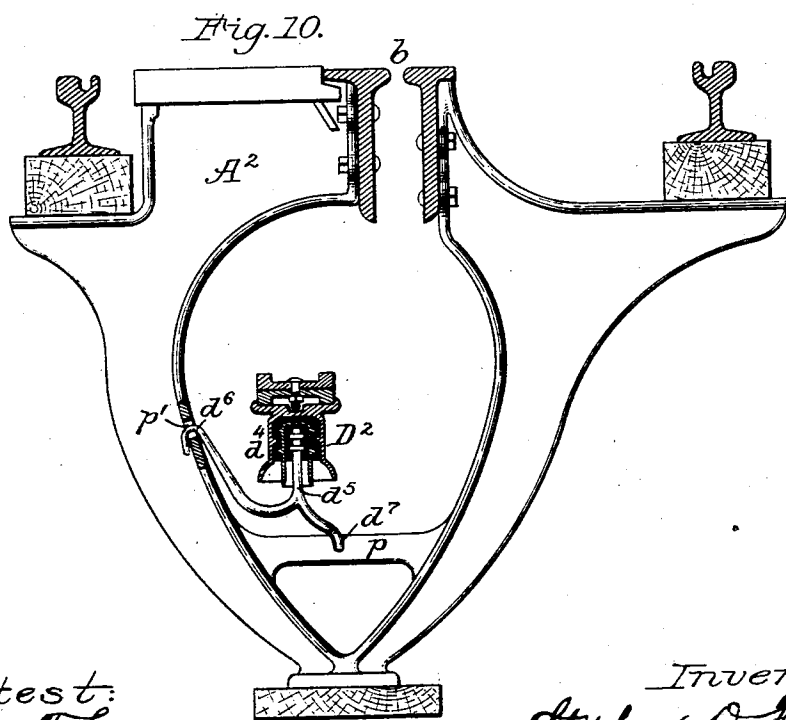
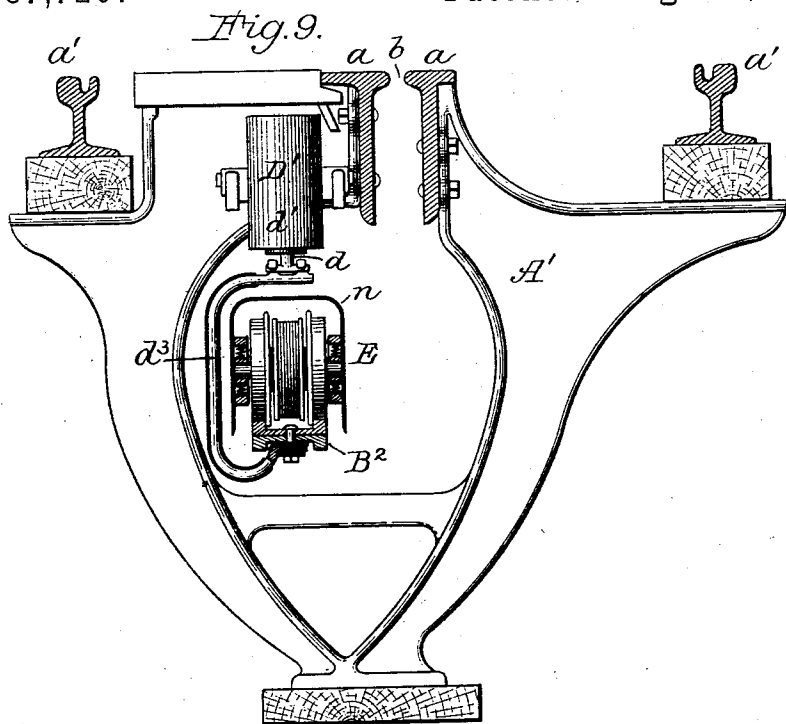
(No Model.)

3 Sheets—Sheet 3.

S. D. FIELD.
ELECTRIC RAILWAY SYSTEM.

No. 587,720.

Patented Aug. 10, 1897.



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UNITED STATES PATENT OFFICE.

STEPHEN DUDLEY FIELD, OF STOCKBRIDGE, MASSACHUSETTS, ASSIGNOR,
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ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 587,720, dated August 10, 1897.

Application filed November 21, 1891. Serial No. 412,653. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN DUDLEY FIELD, of Stockbridge, in the county of Berkshire and State of Massachusetts, have invented certain new and useful Improvements in Electric-Railway Systems; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a clear, true, and complete description of my invention.

Although the main object of my invention is to improve underground or conduit systems, certain of the novel features devised by me are more general in their application—as, for instance, to systems in which overhead conductors are employed, and also to elevated railways with which electric conductors may sometimes be located substantially in the same plane as the rails.

In connection with an underground system I have devised conductors composed of magnetic metal with which magnetic trolleys are employed, and the latter have not only been organized so as to operate in a suspended position, but also so as to override or travel upon the conductor. I have also provided for delivering the supply-current directly to the magnetic or trolley conductors, and also for supplying the working current thereto from a carefully-insulated main conductor by way of suitable short electric conductors at intervals, the supply-conductor being supported by the working conductor. I have still further provided for not only breaking the magnetic or adhesive contact of the trolley with the magnetic conductor at such points as correspond with rail-track junctions, but I do this without impairing the electrical connection as between the magnetic conductor and the trolley. I have also devised specially-suitable conduits and provided for an effective insulation and the reliable support of the magnetic working conductor, these latter serving also as supports for the insulated supply-conductor.

My invention also includes various features in constructive detail and novel combinations, all of which, after description in connection with the drawings, will be duly specified in the several clauses of claim hereunto annexed.

Referring to the drawings, Figure 1 illustrates in cross-section a magnetic conductor and one form of conduit as devised by me, one of the slot-rails serving as one track-rail in connection with a single line of regular track-rail. Fig. 2 illustrates in edge view a magnetic conductor with one of my trolleys suspended therefrom in side view, but without its protecting-shield. Fig. 3 is a cross-section of Fig. 2 through the axis of the trolley, the protecting-shield being indicated in dotted lines. Fig. 4 is a longitudinal central section of the trolley. Fig. 5 is a sectional view of the conductor and a front end view of the frame of the trolley, and illustrates its connection with the trolley-arm, which occupies the slot of the conduit and is connected with the motor-car. Fig. 6 illustrates lengths of magnetic conductor in top view and section and their combination with a supply-conductor. Fig. 7 illustrates a novel construction of the magnetic conductor at “frogs” or turn-outs. Fig. 8, in side view and cross-section, illustrates another form of magnetic conductor with a supply-conductor carried thereon. Fig. 9 illustrates another arrangement of the magnetic conductor in a conduit with which two regular track-rails are employed. Fig. 10 illustrates a similar conduit with the magnetic conductor mounted therein for use with an overriding trolley.

In Fig. 1 the conduit-frame A is so shaped that one of the slot-rails *a* serves as a track-rail in connection with a regular track-rail *a'*, supported upon an arm of the frame, preferably with a cushioning-sleeper. These frames being located at proper intervals the walls of the conduit are formed after the manner usual in cable-conduits, it being obviously desirable that the inclosed space should be fully accessible to workmen. The cross-brace *a*² here shown enables other parts of the frame to be made somewhat lighter than the frames commonly used in cable-conduits. The vertical central line of this conduit is located well to the one side of the trolley-slot *b*, for affording a liberal space which is well guarded against water and other matter liable to drop through the slot. It is in this guarded space that I locate the electric conductors, which in this instance are com-

plex, in that they include a working conductor B, composed of uninsulated magnetic metal, as soft iron or steel, and a highly-insulated supply-conductor C, preferably composed of copper, highly insulated, and supported upon or by the working conductor, which is in turn supported upon or suspended from insulators D, which have trunnions *c* and are pivotally mounted upon forked brackets or arms *c'* on the conduit-frames. The insulation as between the trunnions *c* of the metal shell *d'* and the arms *c'* is rendered complete by means of block-bearings *d²*, composed of hard wood well charged with paraffin, said blocks being well seated in suitable recesses on the arms *c'* and projected inwardly, so that the shell of the insulator cannot possibly make contact with the arms.

The pendent stem *d* of the insulator is well secured in solid insulating material within the shell *d'*, and to the lower end of the stem the iron conductor B is flexibly secured by means of a hooked yoke-piece *e*, bolted to the conductor and to which the stem is pivotally connected. As thus constructed it will be seen that the connection of the insulator with the conduit-frame, by means of the trunnions and bracket-arms, precludes watery condensation from flowing downward along contact-surfaces from the frame A upon the insulator; also, that although the conductors are quite heavy and liable to more or less longitudinal contraction and expansion, the insulators are exposed only to supporting strains, because of the flexible connections both with the conductor and the frame; also, that the insulators may be readily detached from or applied to both the frame and the conductor. The working conductor B in this instance is composed of separate upper and lower soft-iron plates *f f'*, which are counterparts, each having a plain back and raised or thickened or projecting edges on the opposite side, so that on being bolted together back to back the lower plate *f* affords at its under side a pair of parallel trolley-rails *f²*. These plates at their rails or edges *f²* are thinner than the width of a suitable conduit-slot *b*, and therefore, being separate, they can be readily passed into the conduit by way of the slot and bolted together within the conduit, this being a specially-desirable feature. The oppositely-projecting edges in this composite conductor serve as braces or stiffeners, and while obviating undue bulk and weight of metal they are but little liable to undue deflection between the insulators. In uniting the plates they are arranged so as to break joints at their ends, thus making the conductor practically continuous and securing smooth track-rails for the trolley. The abutting ends of the iron conductors should be well squared off and rendered electrically continuous by means of sheet-copper and solder, or by bridge-strips soldered or riveted. In some cases the iron conductor will be solely relied upon, but for long lines and heavy cur-

rents the supply-conductor C should be used therewith, and in either case the lower surface of this iron conductor will be always clean and afford reliable trolley-contact.

The supply-conductor C, preferably composed of copper, is heavily insulated, and it is supported on the top plate *f'* of the working conductor, and being, therefore, absolutely free from strains and not exposed to blows or friction the insulating-jacket is but little liable to injury. The conductors are supported at quite frequent intervals by the insulators, and at intervals of several hundred feet the supply-conductor is connected by short wires *g* with the iron conductor, as shown in Fig. 6, thus providing for economically working extra-high tension-currents. This combination of a magnetic metal working conductor carrying an insulated supply-conductor is specially valuable, because the magnetic flow induced from the insulated supply-conductor will oppositely magnetize the iron conductor at its edges or trolley-rails and enable them to cooperate in maintaining adhesion with a magnetic trolley.

The trolley E operates after the manner of the magnetic trolley devised by me and heretofore disclosed in my application for Letters Patent, filed March 3, 1891. (See Patent No. 508,539, dated November 14, 1893.)

This trolley, as illustrated in Figs. 2 to 5, inclusive, involves certain novel features, however, which will be described in detail. My trolleys carry shields which not only serve as electric insulators but also protect them against defilement by foreign matter, said shields being shown in dotted lines in Fig. 3, and otherwise shown in Fig. 9.

As in my prior trolleys the wheels *h* and their axles *h'* are of iron, but they are now provided with flanges *h²*, composed of gun-metal or other non-magnetic material. The axle *h'* has its bearings in journal-boxes *h³*, internally chambered and supplied with plumbago or suitable carbon to serve not only as a dry lubricant but also as a good electric conductor, and said boxes are mounted in slots in the trolley-frame *i* near one end and between suitable cushioning-springs, good electric conductivity between the boxes and the frame being secured not only by the contact of the boxes and by way of the springs, (if of metal,) but also by way of flexible loops or conductors *h³*, electrically connecting the boxes with the iron frame *i*. The exciting-coil *k* on this trolley is stationary and loosely surrounds the axle *h'* between the wheels *h*, and it is firmly supported by suitable wooden cheeks *h⁴* on the frame *i*. The terminals *k'* of the coil *k* are respectively connected with the trolley-frame *i* and with a return-wire or with ground, the terminal *k²* being extended upward through the slot. The other end of the trolley-frame is connected with the foot of a pendent trolley-arm F, which occupies the conduit-slot, and is to be carried by the motor-car in a pendent position. This

trolley-arm is composed of thin flat metal plates, chambered longitudinally or otherwise recessed for the reception of insulated electric conductors, and at its foot it is hook-shaped, as at l , to afford bearings for a trunnioned ring l' , which in turn has bearings in a vertical line for the reception of pivotal studs l^2 on the front end or stem i' of the trolley-frame i , it being understood that said frame, adjacent to its wheels, is composed of metal and that its front end or stem i' is preferably composed of wood, internally chambered longitudinally, as shown, for the reception of the insulated wire k^2 , leading from the coil k and the main conducting-wire m , which is connected with the metallic rear portion of the trolley-frame and passes to the motor. At the bottom of the trolley-arm F there is a spring i^2 , well seated and having its free end extended rearwardly and bearing upwardly against the stem i' of the frame i , so as to normally support the trolley in light contact with the rails of the working conductor. It will be seen that the swiveled joint connection of the trolley-frame and the arm admits of flexibility in lateral and vertical directions without permitting the trolley-frame to have any undue axial movement.

As thus far described it will be seen that the coil k on being excited by way of the shunt-circuit from the trolley-frame and wires k' k^2 will induce opposite magnetism in the two wheels h and that the magnetic circuit will be completed in both wheels and crosswise through the working conductor B , thus securing powerful adhesion and perfect electric conductivity without undue friction and with a minimum of wear, and also that in the event of the exciting-current being cut off the trolley will yet be maintained in light contact by the spring i^2 . The conductors m and k^2 being housed in the central position of the thin trolley-arm they are practically secure against injury, and the arm can be therefore very thin and quite wide for securing desired strength and rigidity as against abutting shocks at its front edge. The trolley-arm F is provided with plates having vertically-curved edges l^3 , which operate as detachable slot-clearers. It will also be seen that the insulated supply-conductor will induce more or less magnetism flowing crosswise in the working conductor, and with the coil k appropriately wound and connected the magnetism from both sources will cooperate in maintaining the trolley and the iron conductor in perfect electric contact, even when no current is passing through the trolley-coil.

In passing over branched working conductors adjacent to junctions, switches, or turn-outs it is important that the trolley should readily follow the car in whichever direction it may take, and I secure this end by appropriate variations in the height of the trolley-rails, so that on approaching a frog the trolley will ride on its gun-metal flanges until

the frog is passed, as illustrated in Fig. 7. At the junction G , on the working conductors B and B' , the trolley-rails f^2 f^2 are gradually lessened in height, or, what amounts to the same thing, the intervening portion of the conductor is made gradually thicker, so that as the trolley passes from the normal positions on the rails the iron treads of the wheels will be removed from contact with the rails f^2 , and then the gun-metal flanges will serve as conducting-treads on the body of the conductor, as at G' , until after the frog is fully passed, whereupon the trolley will again resume its magnetically adhesive contact relations with the conductor.

It will not be always advisable to utilize one of the slot-rails as a track-rail for car-wheels, and hence in Fig. 9 I have shown a conduit-frame A' , adapted to support two regular track-rails a' a' , the slot b , with its rails a a , being therefore located centrally instead of at the one side, as in Fig. 1. In this case I have shown the working conductor B^2 without a supply-conductor, although the latter may be used therewith, and I have also shown the trolley E as overriding the working conductor instead of running against the under side thereof. This trolley is mainly as before described, except that no supporting-spring is needed. This insulator D' is, however, specially organized, so as to engage with the bottom surface of the conductor B^2 . The shell d' and its stem d are as before described, but I here use a C-shaped steel arm d^3 , which is well insulated and suspended from the insulator-stem d , and is bolted at its lower end to but insulated from the working conductor B^2 at its under side, so that although the conductor and the insulator-shell are in the same vertical plane, and hence well and evenly supported, ample space is afforded between that plane and the pendent arm d^3 for the trolley to freely pass, but for the better protection of the trolley it is provided with an insulating hood or shield n , of rubber or vulcanized fiber, which not only guards the trolley against falling foreign matter, but also serves to insulate it electrically, especially when passing the pendent arms of the supporting-insulators.

Although it is preferable that the supply-conductor should be located between the trolley-rails of the working conductor it may be located at one edge of the working conductor, as illustrated in Fig. 8. In this case the lower plate has track-rails f^2 , as before described, but at one edge outside of the rail the plate is thin and curved upward, as at f^3 , thus forming a gutter for the reception of concaved blocks f^4 of baked clay, which need only be used at intervals of a foot or so to serve as insulating-supports for the insulated supply-conductor C . The bottom of the iron gutter f^3 is provided with holes at intervals, so that the waters of condensation will be promptly discharged therefrom, similar holes being also

provided in or through the working conductor between the track-rails.

The suspension of the working conductor from the insulators is not always desirable when the trolley travels on the upper surface of the conductor, and hence I have devised vertical supports, as illustrated in Fig. 10. The conduit-frame A^2 is provided with a lateral bar or brace p , preferably integral with the frame, and at one side the frame has a vertically-oval opening or hole, as at p' , and although the slot b is in this instance symmetrical with relation to the track-rails it is located at the one side of the conduit. The insulator D^2 is of the bell form, its shell d^4 being preferably of cast metal, its stem d^3 being firmly fixed therein and well insulated from the shell by means of strong solid insulating matter, such as vulcanized fiber, baked clay, glass, &c. The two parts of the working conductor being bolted together rest firmly on the tops of the metal shells, and are secured against displacement by means of bolts, the ends of which serve as pins, in suitable holes in the tops of the shells. The stem d^3 is preferably composed of malleable iron, and it is peculiarly shaped, having a cross-arm angular to the shank and provided with a hook d^6 at one end and a fork d^7 at the other or lower end, the latter resting upon and embracing the frame brace or bar p and the hook at the upper end entering the hole p' in said frame, thus affording very reliable and economical supporting-insulators, which can readily be put into place or removed. With this arrangement the mounting of the working conductor in position involves but little labor, and even the use of a pin-bolt in the central hole in the insulator-shell may be obviated, if desired, by providing the two sides of the top of the shell with integral lugs or projections, as indicated in Fig. 10.

It will be seen that my system of conduit conductors involves no tensile strains on either the working or the supply conductor, and that the working conductor may be well protected by suitable paint against oxidation except along the tread-surfaces of the trolley-rails, and that when mounted as described a durable and comparatively inexpensive insulation is secured which will admit of the use of heavy electric currents with little liability of leakage. The conduits should of course be well constructed and manholes provided at short intervals for affording prompt access to the conduit. In cold localities heating-pipes may be sometimes used to advantage for avoiding closure of the slot by ice and snow, although the trolley-arm, being of proper strength and vertically curved at its edges, can be relied upon for cleaning the slot and removing such ordinary obstructions as are liable to be encountered on surface-tracks and not disposed of by the pendent aprons or shoes usually employed for that purpose on cable-cars.

Having thus described my invention, I

claim as new and desire to secure by Letters Patent—

1. In an electric-railway system, the combination with a slotted conduit embodying metal frames, of insulators flexibly mounted on arms projecting from said frames, and a working conductor composed of magnetic metal flexibly suspended from said insulators, substantially as described.

2. In an electric-railway system, the combination with a conduit having a trolley-slot, of a working conductor composed of magnetic metal located in and near one side of said conduit remote from the slot, and a well-insulated supply-conductor supported by the working conductor, and electrically connected thereto at intervals, substantially as described.

3. In an electric-railway system, a slotted conduit, a working conductor composed of magnetic metal and affording parallel trolley-rails; a magnetic trolley having wheels adapted to roll on said rails with magnetic adhesion, and a trolley-arm flexibly connected to the trolley, and adapted to occupy the conduit-slot, and carried in a pendent position by a motor-car, substantially as described.

4. In an electric-railway system, the combination with a slotted conduit, of a working conductor, composed of magnetic metal, formed into bars or plates, plain at the back side, and each having at the opposite side projecting edges, the backs being in contact, and the plates firmly united, substantially as described, said bars being readily inserted separately into the conduit by way of the slot, and then readily assembled and united, one pair of the projecting edges serving as trolley-rails and both pairs as stiffeners or braces in the conductor.

5. In an electric-railway system, the combination substantially as hereinbefore described, of a suitable working conductor composed of magnetic metal, and a magnetic trolley provided with conducting-wheels, mainly of magnetic metal but having flanges composed of non-magnetic metal, whereby each wheel has a magnetic tread-surface adapted to roll in magnetic adhesion along the working conductor, and also a flange serving as a reliable electric conducting-contact, and at times serving as the tread of the wheel for separating the magnetic tread-surface of the wheel from the conductor, as at branches or turnouts.

6. In a magnetic trolley a pair of wheels adapted to roll in magnetic adhesion with a working conductor composed of magnetic metal, a frame in which said wheels are mounted, and a stationary exciting-coil carried on said frame, between the wheels and concentric with their axle, substantially as described.

STEPHEN DUDLEY FIELD.

Witnesses:

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