(No Model.)

W. E. M. JACKSON.

CONDUIT ELECTRIC RAILWAY.

No. 540,060. Patented May 28, 1895.

Fig. 1.

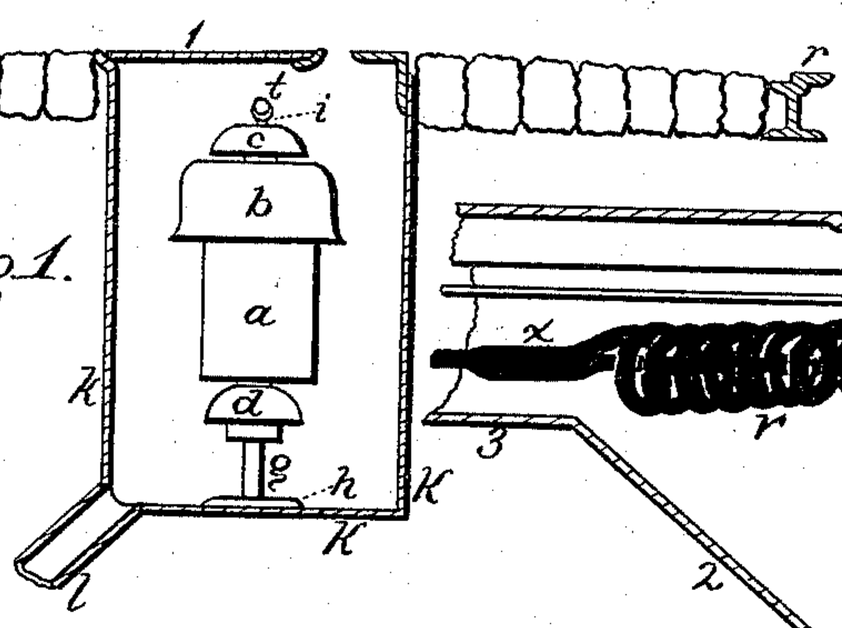

Fig. 2.

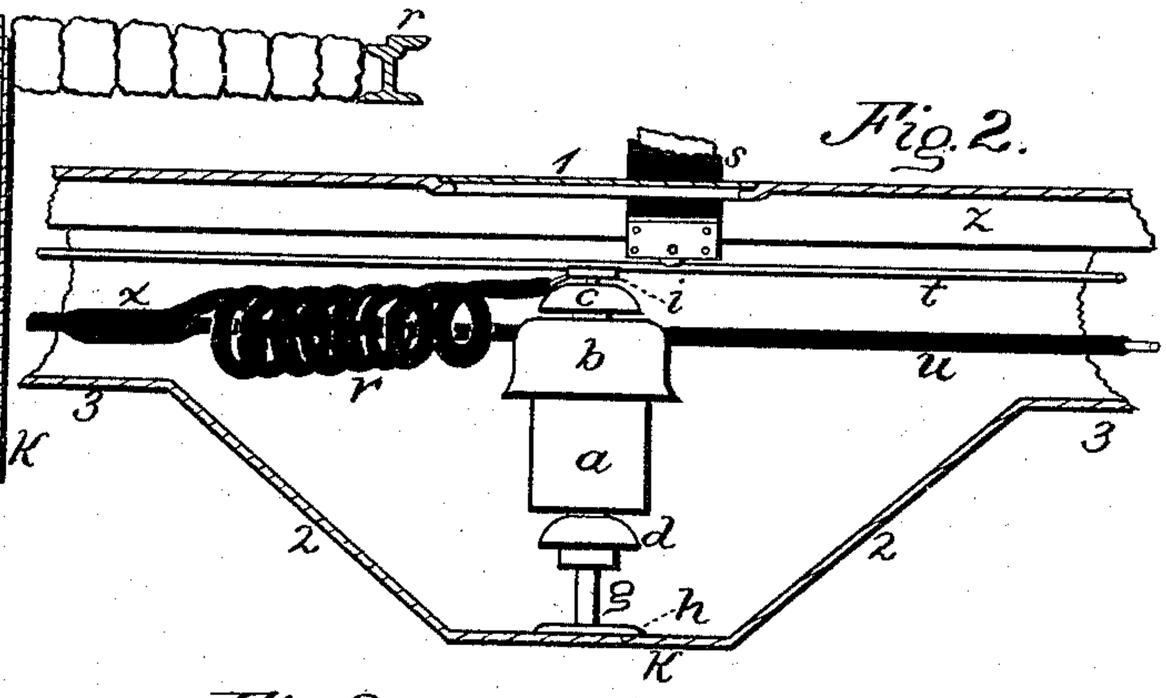

Fig. 3.

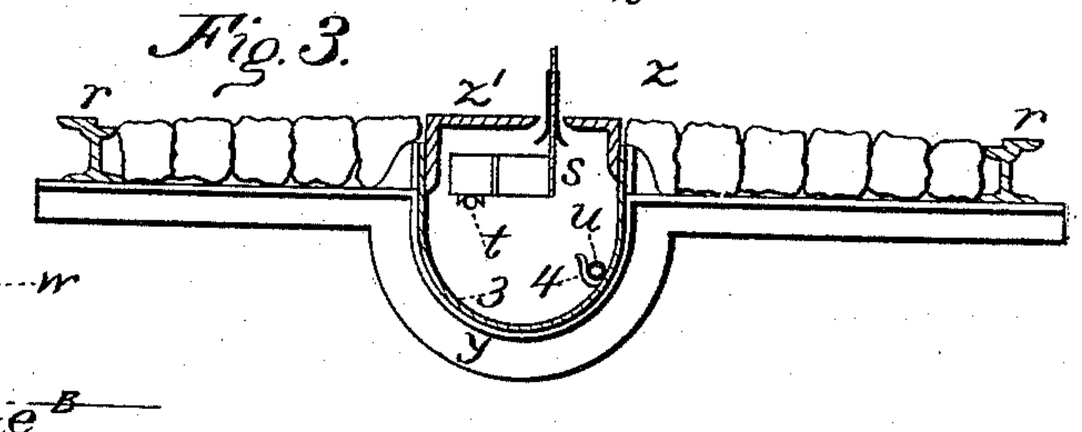

Fig. 4.

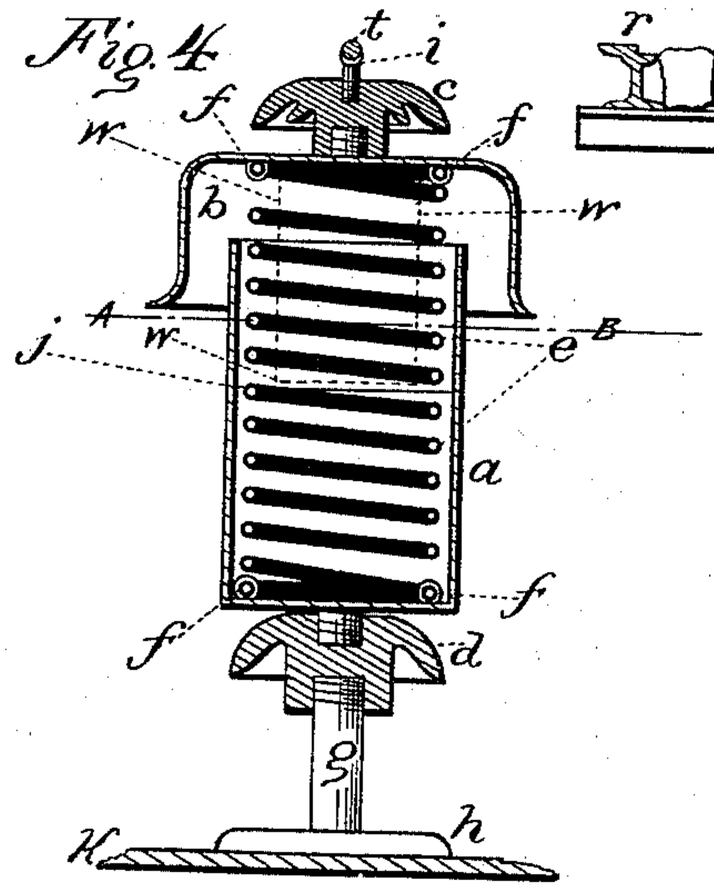

Fig. 5.

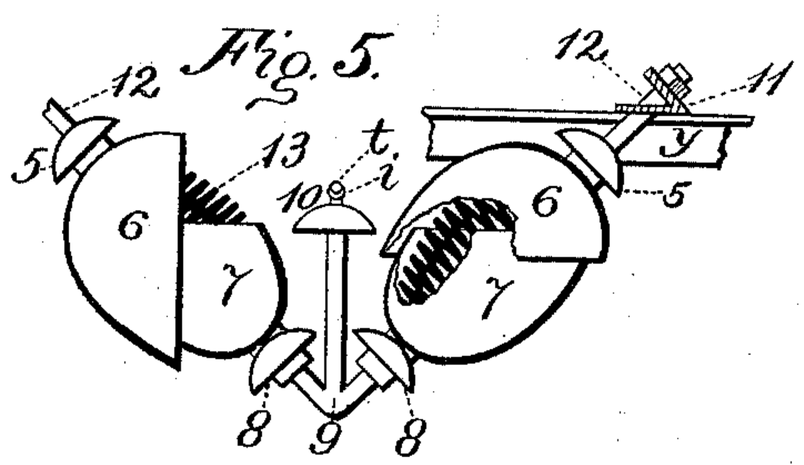

Fig. 6.

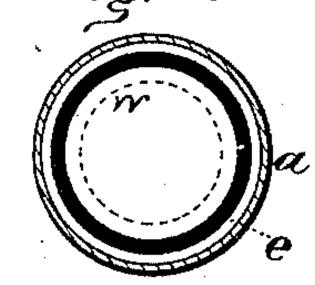

Fig. 7.

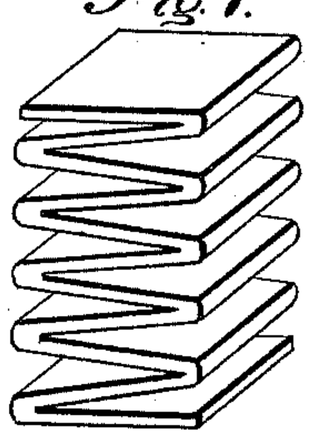

Fig. 8

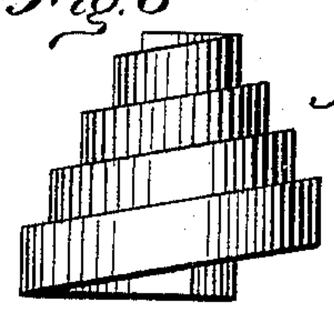

Fig. 9. Fig. 10. Fig. 11

Fig. 12. Fig. 13.

Fig. 14.

Witnesses:
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UNITED STATES PATENT OFFICE.

WILLIAM E. M. JACKSON, OF SAN FRANCISCO, CALIFORNIA.

CONDUIT ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 540,060, dated May 28, 1895.

Application filed October 25, 1893. Serial No. 489,141. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. M. JACKSON, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Conduit Electric Railways, of which the following is a specification.

My invention specially relates to improvements in the insulation of the conductors, or trolley wires. Heretofore the greatest difficulty has been found in preserving good insulation in a slotted conduit system on account of the surface leakage, such leakage being much aggravated by the deposition of moisture and dirt upon the insulators commonly used. The better insulation resulting from the use of petticoated insulators is well known, the improvement being mainly due to the increased surface over which the leaking current has to travel. If, therefore, following up this principle, the path of the leaking current can be vastly increased, without making the appliance too unwieldy, it is obvious that a practical method of insulating heavy current wires would result. In my apparatus I have aimed to accomplish this by using a long surface of the insulating medium, coiled, or otherwise bent, twisted or turned, so as to bring it within practicable limits, one or more of such coils forming the support for the conductor. A leaking current would then have to follow the entire length of such surface and would be greatly diminished. As it is difficult to use a homogeneous insulating material in this form and retain the requisite strength and elasticity for support, I prefer to use a metal core covered entirely with the insulating medium. This core can be of any required cross-section and length and can be made of many different metals, but I prefer to use a heavy round wire of steel, brass or other spring metal. The covering can be of any elastic insulating material of sufficient thickness to prevent discharge through it to the core. Many of the compounds of rubber or gutta percha now on the market as coverings for high potential wires will answer, but I prefer to have the outside surface smooth and glossy. The form can be that taken by any open coil spring,—a simple spiral, a tapering spiral, a volute, double volute, spindle, &c., or it can be bent on one plane, back and forth,—as desired. I prefer a simple open coil spring or open spindle spring, with a circular cross section. The attachments can vary with the design, but in every case the insulating medium should interpose between the attachment and the metal core. While the arrangement so far indicated insures an insulator with a high surface resistance, it is plain that in the course of time the surface will become coated with dirt. To avoid this I place each coil in a covering consisting of two parts, the top part overlapping, but not touching, the lower part. These covers can be made either of insulating material, such as hard rubber, or of thin metal, the air gap between them serving to prevent leakage from the upper to the lower. In the lower cover (called the cup) oil, or other suitable insulating liquid, can be placed so as to partially submerge the coil. In this arrangement, which is particularly adapted to a conduit electric railway, when the coil is compressed or extended by the trolley passing over it the oil is agitated and a part of the coil either emerges therefrom or is submerged, it being thus kept clean and given periodically a fresh coating of oil. A plunger can be used to further agitate the oil and increase its displacement.

In the accompanying drawings, Figure 1 represents a cross-section of a conduit railway at an insulator-chamber. Fig. 2 is a lengthwise section at same point. Fig. 3 is a cross-section of the ordinary conduit. Fig. 4 shows the insulator complete in vertical section. Fig. 5 is another form of the insulator. Fig. 6 is a cross-section through line A B in Fig. 4. Figs. 7 and 8 show other forms of the insulating-support. Figs. 9, 10, 11, 12, and 13 show various cross-sections of insulating-supports which may be used. Fig. 14 is a cross-section of an insulating-support made of homogeneous material.

An open spiral, *e*, consisting of a metal core surrounded entirely by elastic insulating material, is attached to the inside bottom of the cup, *a*, and also to the cover, *b*, by the fasteners, *f*, *f*, *f*, *f*. The spiral does not touch the sides of the cup nor those of the cover, and the cover is made of greater diameter than the cup and overlaps its top edge for a short distance. The cover is preferably made bell

shaped, the better to shed water. To the top of the cover the petticoated insulator, *c*, is attached supporting the trolley wire, *t*, by means of the support, *i*. To the bottom of the cup another petticoated insulator, *d*, is attached, supported by the standard, *g*, attached to the bed plate, *h*, which in turn is attached to the bottom of the containing chamber, *k*. Assuming that the cup, *a*, and the cover, *b*, are made of insulating material and that all the insulating material used is of sufficient thickness to prevent discharge through it, any current leakage from the trolley wire, *t*, would have to pass over and under the insulator, *c*, over and under the cover, *b*, along the entire spiral length of *e*, on both the inside and outside of the cup, *a*, over and under the insulator, *d*, and thence through the standard, *g*, to the containing chamber, *k*, where it would necessarily find a ground. It will thus be seen that the insulation resistance is vastly greater than that obtained with an ordinary insulator.

It has been assumed that the cup, *a*, and the cover, *b*, are made of non-conducting material. While it would increase the efficiency of the complete insulator to have them so constructed, it is not absolutely necessary and their use when so made, as also the use of the petticoated insulators, is complementary to the use of the insulating spiral. When made of sheet metal the function of *a* and *b* will be to keep the spiral clean. The whole insulator will be stiff but not rigid, the spring of the open spiral, *e*, being only sufficient to allow of compression when a considerable force, such as would be exerted by a moving trolley roller, whose normal position is lower than the normal position of the trolley wire, *t*, where it is attached to the insulator, passing over it, and too stiff to permit any considerable lateral motion which might allow the spiral to come in contact with the sides of the cup.

As thus described the apparatus forms a complete insulator in itself; but, as a further adjunct, the cup, *a*, can be partly filled with an insulating liquid, such as oil, say to the level of the line *j*. In this case every time the spiral is compressed by the trolley passing the insulator a certain number of its coils will be immersed in the oil, and when the trolley has passed and the spiral has resumed its normal position the coils so immersed will have been cleaned and given a coating of oil. To further increase the agitation of the oil and the number of coils of the spiral immersed therein, a plunger, shown by dotted lines, *w*, *w*, *w*, can be attached to the inside of the cover with its free end close to the surface of the oil. This plunger will, when the trolley passes, displace some of the oil, causing it to rise higher and immerse more of the coils. It can best be made of insulating material and can be hollow, closed at the lower end, for lightness. I place these insulators at convenient distances, say thirty feet apart, in chambers under the road bed, attaching the trolley wire to the top of each, as shown. Between the supports the trolley wire will be somewhat slack, the lowest point, midway between the supports, being the level at which the trolley, *s*, travels. The trolley will be vertically rigidly attached to the car, and when it moves toward one of the insulators it will therefore gradually depress the trolley wire, the maximum depression being at the insulator.

In Fig. 1 the trolley wire and insulator are shown in normal position, undepressed.

In Fig. 2 the trolley is about to pass over the insulator and the latter, with the the trolley wire, is depressed.

Any convenient form of trolley can be used, that which I have shown consisting simply of a wheel with a right angled support and with insulating plates to prevent electrical connection between the metal of the support and the slot pieces.

In Fig. 3,—a section through the ordinary conduit between the insulators,—a yoke piece, *y*, supports the curved channel piece, 3, and the slot pieces, *z*, *z'*. The feeder wire, *u*, is shown supported by hook 4, and the trolley wire, *t*, covered by the trolley, *s*, is shown at the lowest level.

I make no specific claim for novelty in the form of conduit or trolley shown, as many different designs may be employed in combination with the other parts. The channel piece, 3, I prefer to slant downward at the containing chambers of the insulators, as shown at 2, 2, Fig. 2, to facilitate drainage from the conduit proper into these chambers. Each chamber can be then drained by a pipe, *l*, into the sewer or a cesspool. For the sake of clearness in the drawings the fastenings or bolts of the rails, *r*, *r*, and the different parts of the conduit, are omitted.

The feeder wires can be carried in the conduit in other ways than that shown, or can be placed in a special compartment. All feeder wires are to be insulated and when connection is made from a feeder to the trolley wire, the legged wire for such connection, also insulated, is coiled, as shown in Fig. 2, where *v* represents the coiled leg and *x* the splice to the feeder wire. This coil, which is an open spiral, serves to greatly increase the surface any leakage current from the trolley wire would have to travel over in order to find a ground *via* the surface of the feeder and through its supports. It is obvious that the leg from the feeder can be bent or twisted upon itself, in other forms than the spiral, to attain the same end.

A cover, 1, is provided over each containing chamber so as to afford ready access to the insulators. When an insulator requires cleaning it can be disconnected from the trolley wire support, *i*, and a temporary support used to take the place of the insulator in the meantime.

As illustrated, turning *a* and *b* in one direction would disconnect between *c* and *i* and between *a* and *d*, and turning in the other di-

rection would disconnect between *b* and *c* and between *g* and *d*. In either case other disconnections can be made subsequently. It is evident that by using right and left threads other ways of disconnecting can be produced. I prefer to have the standard, *g*, rigidly attached to the plate, *h*, and the latter rigidly attached or permanently bolted to the floor of the containing chamber, *k*, but many different combinations of the different parts may be used.

In a double trolley system the arrangement with an enlarged containing chamber with two insulators will readily suggest itself.

In the modification shown in Fig. 5 two insulators are used to support the trolley wire by means of the stem, 9. The spiral in each insulator is spindle shaped and the cup, 7, and cover, 6, conform to the altered form of the spiral. The corresponding petticoated insulators are shown at 5 and 8, and at 10 is shown a fifth petticoated insulator under the trolley wire. In this arrangement the insulators will be suspended and will preferably be attached to a cross bar, one on each side, shown as an acute angled piece at 11, supported by the yoke irons, *y*, on each side of the containing chamber. On the right hand insulator the cover, 6, and cup, 7, are partly broken away to show their relative position and the spiral inside. Oil can also be used in the cup, 7, but as the pressure of the trolley will extend, and not compress the spiral, some of the coils will be freed from the oil, instead of immersed, during the passage of the trolley. In the left hand insulator the cover, 6, is shown turned half way round, which position permits of the spiral and the contents of the cup being examined. Normally both covers will be in the position shown on the right.

I do not limit myself to the two forms of complete insulators shown in Figs. 4 and 5 nor to the use of these insulators for conduit electric roads. It is plain that a great variety of forms, not only of the prolonged insulating surface (corresponding to the spiral, *e* or 13), but of the complete insulator may be used. Figs. 7 and 8 show two, out of many, forms which can take the place of the spiral when suitable attachments are provided, and Figs. 9, 10, 11, 12, and 13 show a few out of many cross sections of same which may be used. The idea underlying the use of the insulating spiral, and all forms which may be substituted, is to provide a long insulating surface, relatively small laterally, bent, twisted or coiled into convenient compass, but so that the surface throughout shall be free from contact, either with other portions or extraneous objects, except where secured at the ends. While for considerations of strength and economy it is desirable to use a metal core covered with insulating material, I do not limit myself to this construction.

In Fig. 14 I have shown a cross section of homogeneous insulating material and all the forms which I have otherwise indicated can be so constructed. In all cases where ordinary insulators are used, those I have described, or modifications thereof, can be applied, and I desire my application to cover the general use for purposes of electrical insulation.

I claim—

1. The improvement in the art of electrical insulation which consists in giving to the insulating support a prolonged free surface, relatively narrow laterally, and coiling, bending or twisting same within convenient compass, substantially as described.

2. An insulating support comprising an open spiral, or other form in which a piece of relatively small cross section and great length is bent or twisted upon itself with a long continuous free surface, formed in whole or part of insulating material, substantially as described.

3. An insulating support comprising an open spiral, non-conductive, a containing cup and a cover, combined substantially as described.

4. An insulating support comprising an open spiral, non-conductive, a containing cup, a cover and one or more auxiliary petticoated insulators, combined substantially as described.

5. An insulator comprising a compressible open spiral, non-conductive, a containing cup, a cover and a non-conductive fluid in said cup, combined substantially as described.

6. In an insulator a compressible open spiral, non-conductive, a containing cup, a cover, a non-conductive fluid in said cup and a plunger to partially displace said fluid, combined substantially as described.

7. In an insulating support an open spiral comprising a core of spring metal covered with an insulating material, substantially as described.

8. In an insulating support, an open, compressible spiral, or other form in which a piece of relatively small cross section and great length is bent or twisted upon itself, with each bend twist or coil free from contact, except where secured, comprising a core of spring metal covered with an elastic insulating material, combined with suitable fastenings at or near each end substantially as described.

9. In a conduit electric railway the combination of a trolley wire, a suitably slotted conduit, with accessible chambers situated at intervals, and insulating trolley wire supports contained in said chambers, each such support comprising an open spiral, non conductive, a containing cup and cover, substantially as described.

10. In a conduit electric railway the combination of a trolley wire, a slotted conduit, with accessible chambers situated at intervals, and insulating trolley wire supports contained in said chambers, each of said supports comprising a compressible open spiral, non-conductive, a containing cup, a cover, an

insulating fluid in said cup and a plunger to partially displace said fluid, substantially as described.

11. In a conduit electric railway, a suitable slotted conduit, with accessible chambers situated at intervals, one or more trolley wires, insulating trolley wire supports contained in said chambers, each of said supports comprising a compressible open spiral, non conductive, a protecting cup, a protecting cover, both cup and cover free from contact with said spiral except where attached thereto, one or more petticoated insulators, a plunger attached to said cover and a non-conducting fluid contained in said cup, normally free from contact with the plunger, combined with one or more trolleys and the necessary electric car equipments in such a manner that a trolley passing over an insulating support shall compress its spiral, substantially as described.

12. In an insulator, a spring support, with a prolonged free insulating surface and relatively small cross section, coiled, bent or twisted within convenient compass, a containing cup and its cover and a quantity of oil, or other non-conductive fluid, in said cup, combined substantially as described.

13. The improvement in the art of insulation which consists in combining a spring support, with a prolonged free insulating surface and relatively small cross section, coiled bent or twisted within convenient compass, with a containing cup and a quantity of non-conductive fluid therein, so that the depression and extension of said spring support shall agitate said non-conductive fluid and clean said support, substantially as decribed.

14. A protection covering for an insulator comprising a cup, in which the insulator is supported, and a cover attached to the top of the insulator, said cup and cover being free from contact with the insulator, except where attached, and free from contact with each other, and said cover overlapping the edge of said cup, substantially as described.

15. In a conduit electric railway, a slotted conduit with accessible chambers situated at intervals, each chamber containing one or more insulating trolley wire supports, each of said supports comprising a compressible open spiral with a non-conductive surface, a protecting cup, a protecting cover, said cup and cover being free from contact with the spiral, except where attached, and said cover overlapping the brim of said cup but free from contact therewith, one or more auxiliary petticoated insulators, a plunger attached to said cover and a non-conductive fluid, contained in said cup, normally free from contact with the plunger; one or more insulated feeder wires, one or more insulated connecting wires from said feeder wires to the trolley wires, each such connecting wire being formed in an open spiral, one or more electric cars with motor and trolley equipments and one or more trolley wires supported by said insulating supports, each trolley wire being slack between supports, each trolley riding at the lowest level of the trolley wire and each insulating support being depressible by the over riding of the trolley, combined substantially as described.

16. In an insulator, a support with a prolonged free insulating surface and relatively small cross section, coiled, bent or twisted within convenient compass, a containing cup and its cover, and auxiliary insulating attachments, combined together by screw threads or in such a manner as to be readily separated for cleaning or repairs, substantially as described.

17. In an insulator, a support with a prolonged free insulating surface and relatively small cross section, coiled, bent or twisted within convenient compass, combined with auxiliary attachments in such a manner as to be readily separable therefrom, substantially as described.

18. An insulating support comprising an open coil spiral with insulating surface, a containing cup and its cover, an auxiliary attachment for the conducting wire and another auxiliary attachment and stem for supporting the whole, combined substantially as described.

19. The combination of a conductor and an insulating support comprising an open spiral, or other form in which a piece of relatively small cross section and great length is bent, coiled or twisted upon itself, with a long continuous free surface, formed in whole or part of insulating material, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

WILLIAM E. M. JACKSON.

Witnesses:

EMILE J. ZIMMER,

WM. H. MEAD.