(No Model.) 4 Sheets—Sheet 1.

C. J. VAN DEPOELE.

SYSTEM OF SUSPENDING ELECTRIC CONDUCTORS.

No. 394,039. Patented Dec. 4, 1888.

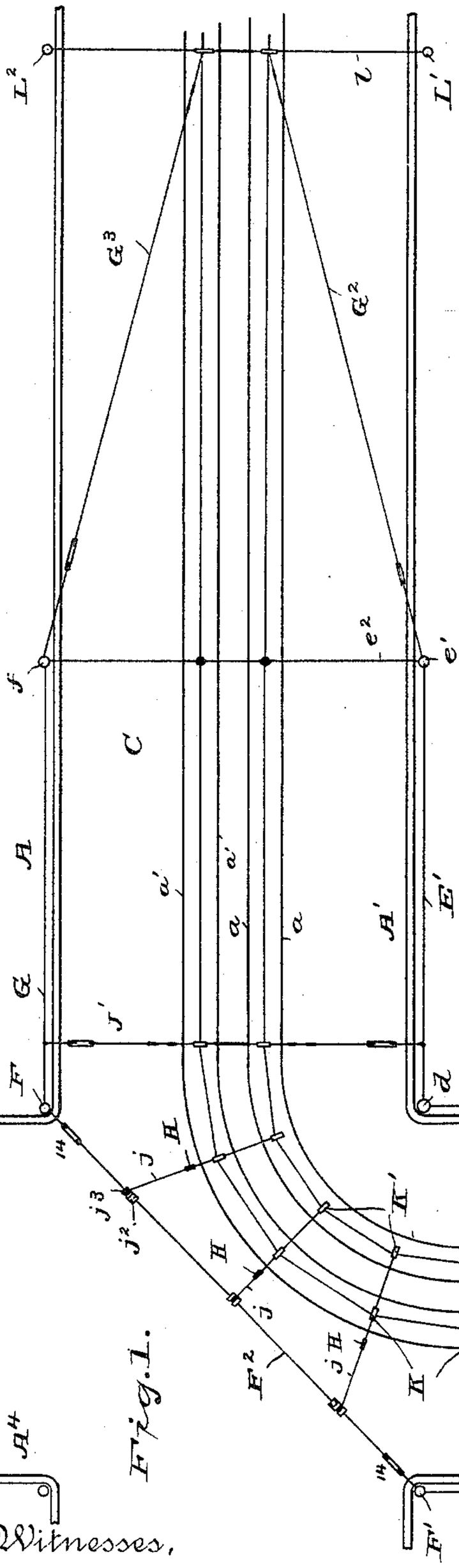

Fig. 10.

Fig. 12.

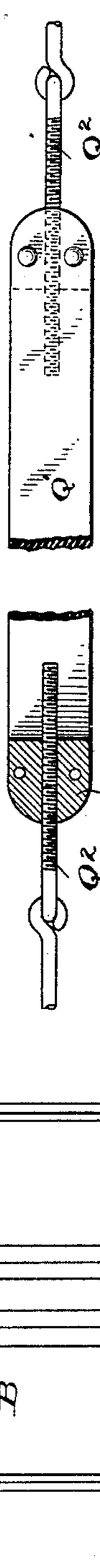

Fig. 11.

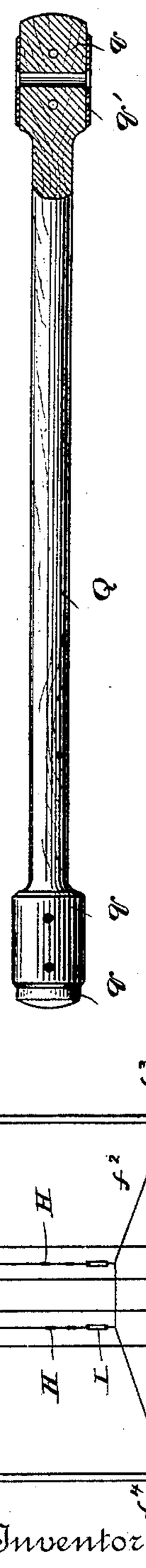

Fig. 1.

Witnesses,

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H. A. Lamb

Inventor.

Charles J. VanDepoele

By Fraukland James.

Attorney.

(No Model.) 4 Sheets—Sheet 2.

C. J. VAN DEPOELE.

SYSTEM OF SUSPENDING ELECTRIC CONDUCTORS.

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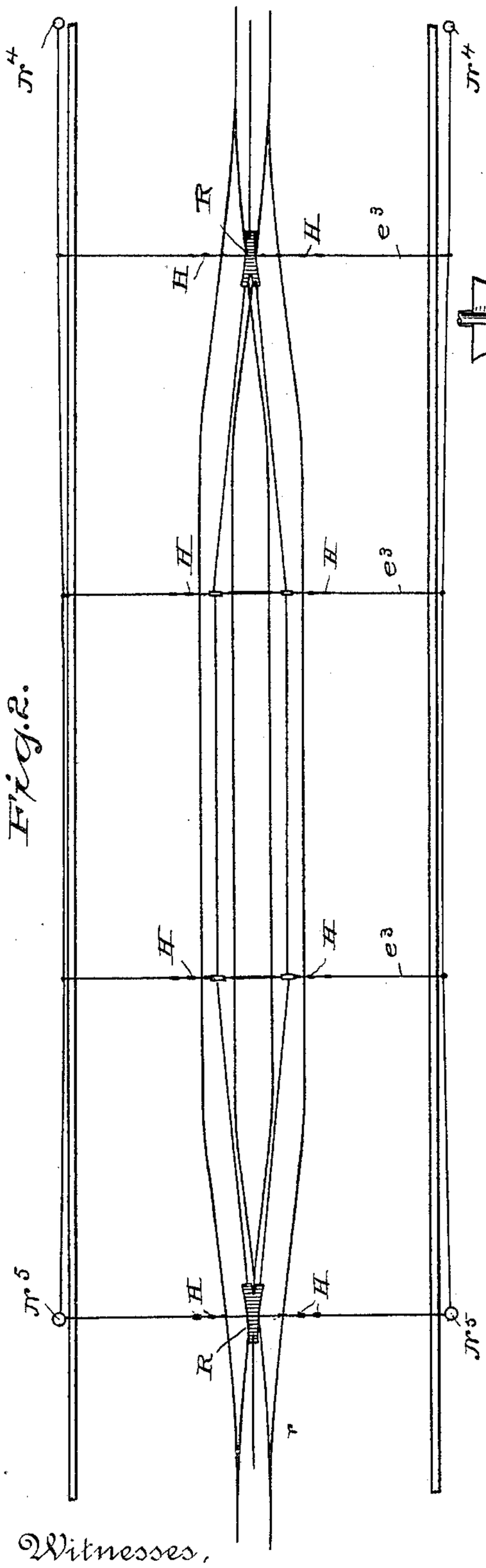

Fig.2.

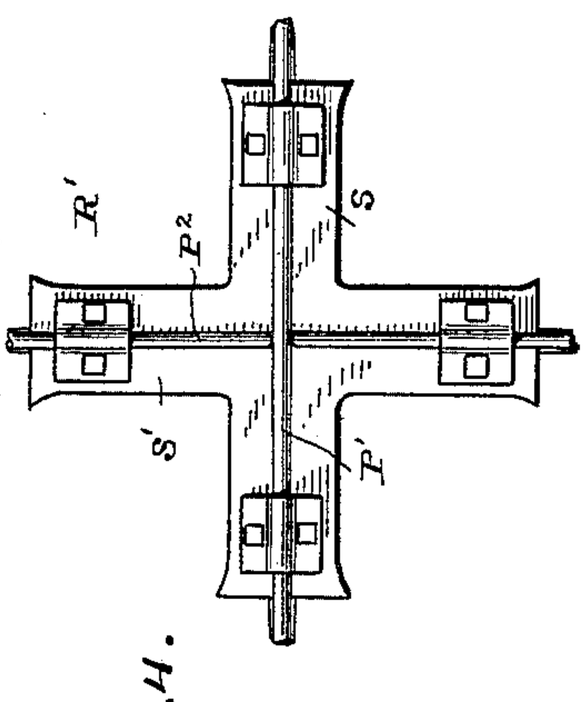

Fig.4.

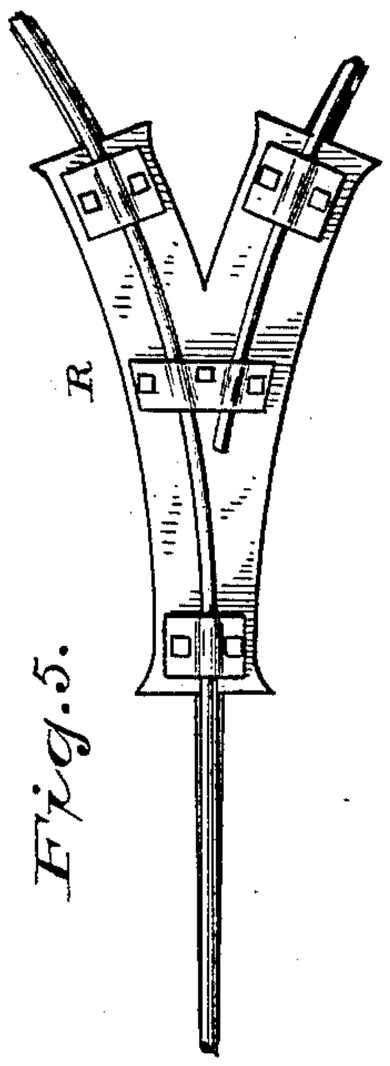

Fig.5.

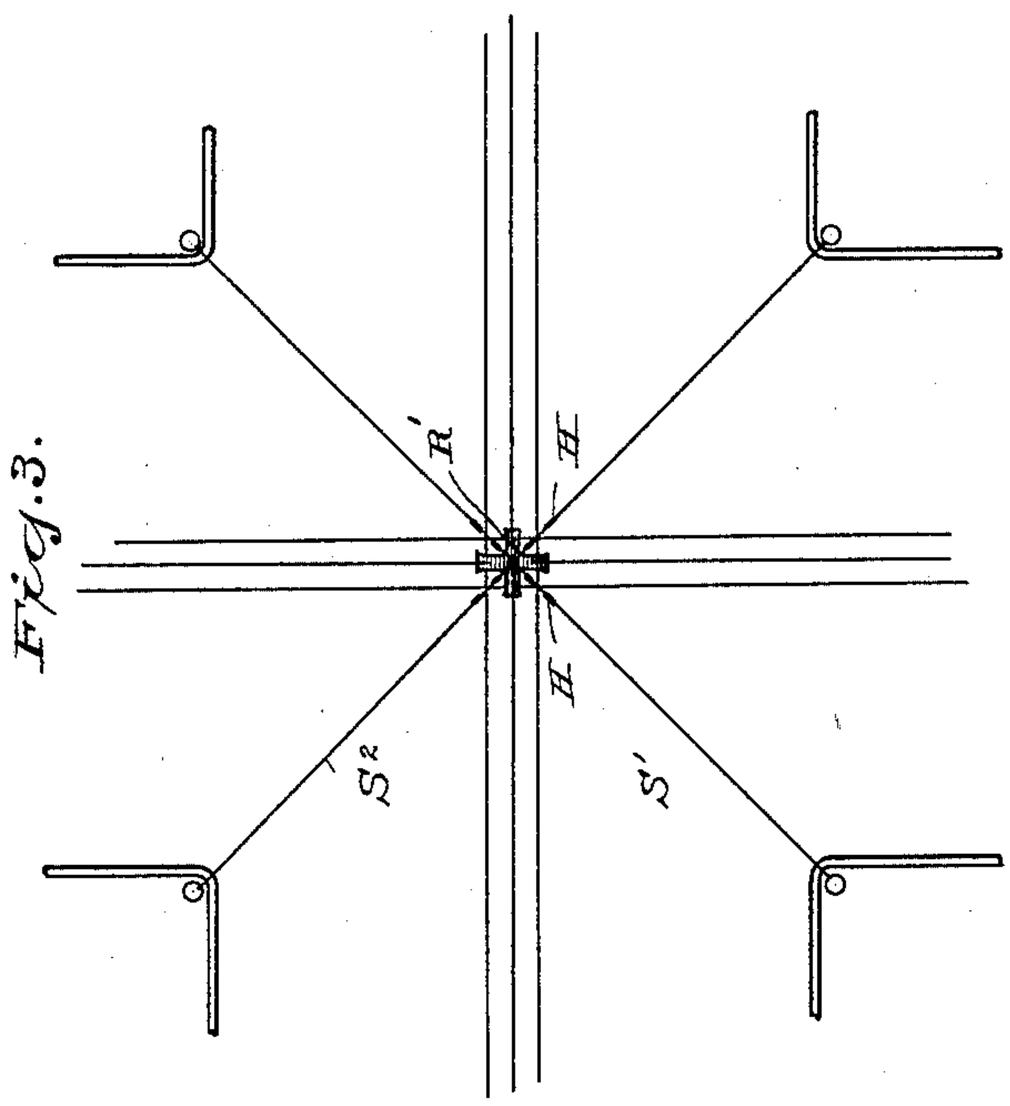

Fig.3.

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(No Model.) 4 Sheets—Sheet 3.

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SYSTEM OF SUSPENDING ELECTRIC CONDUCTORS.

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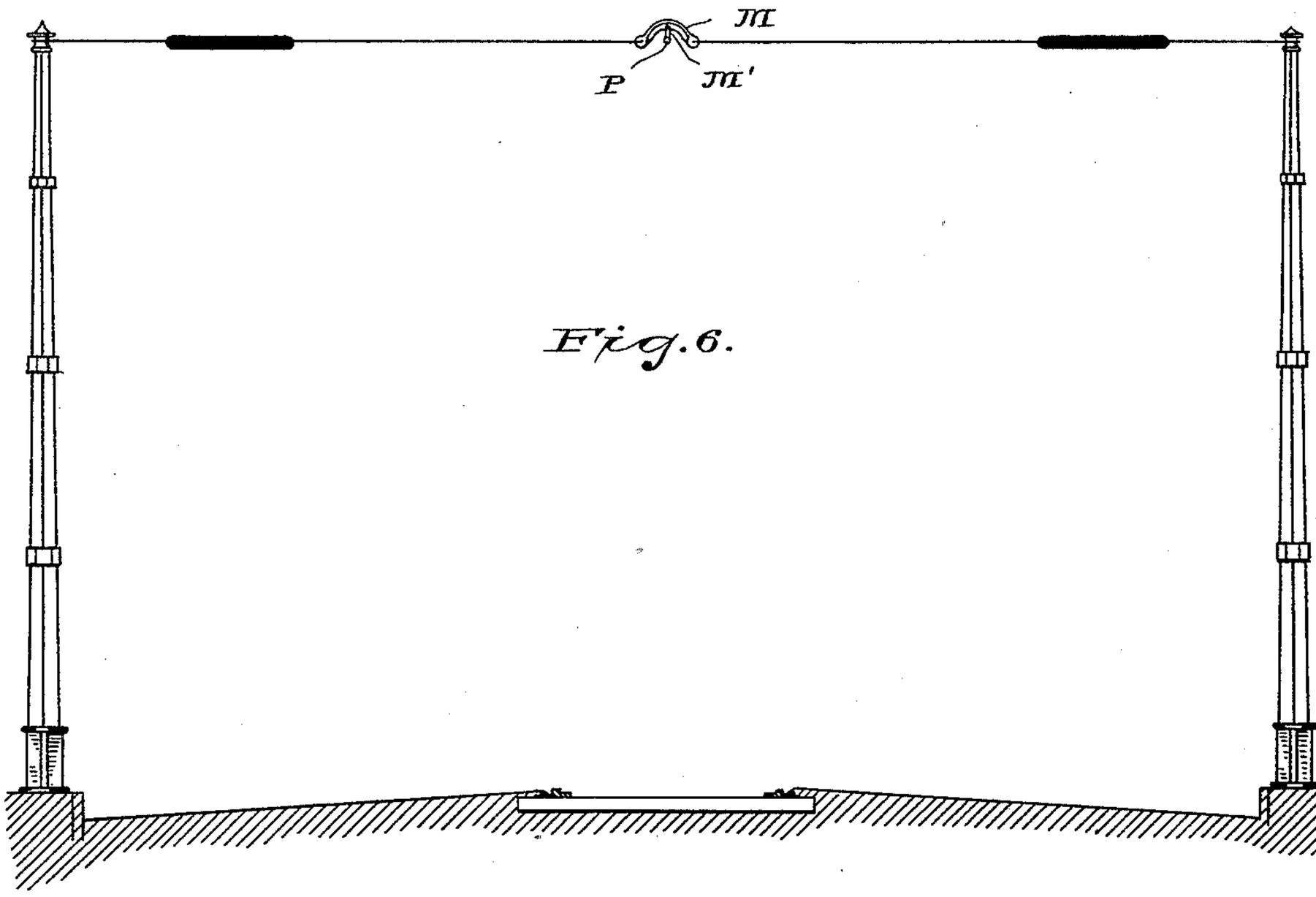


Fig. 6.

Fig. 7.

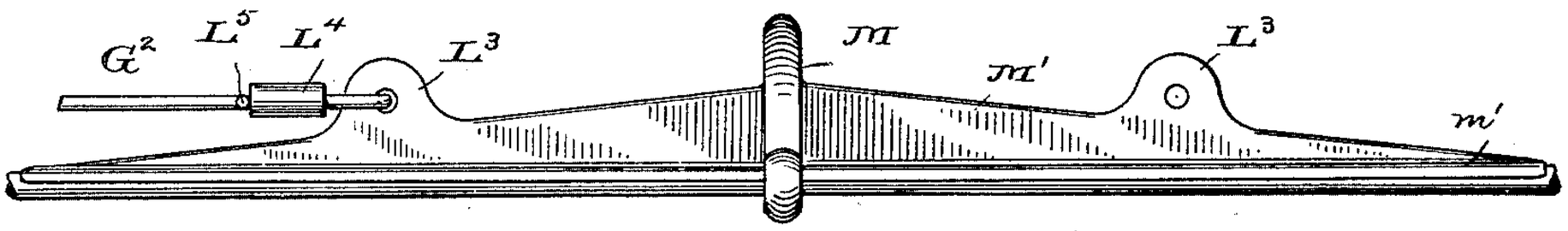


Fig. 9.

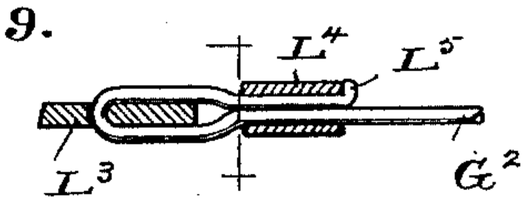
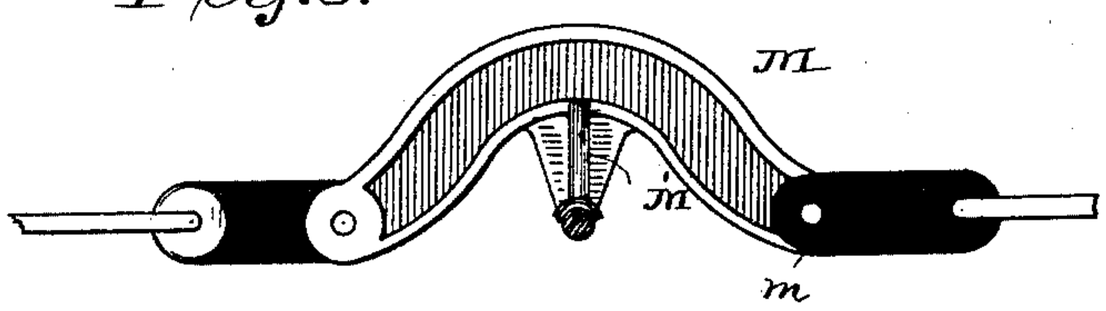


Fig. 8.



Witnesses,
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(No Model.) 4 Sheets—Sheet 4.

C. J. VAN DEPOELE.

SYSTEM OF SUSPENDING ELECTRIC CONDUCTORS.

No. 394,039. Patented Dec. 4, 1888.

Fig. 13.

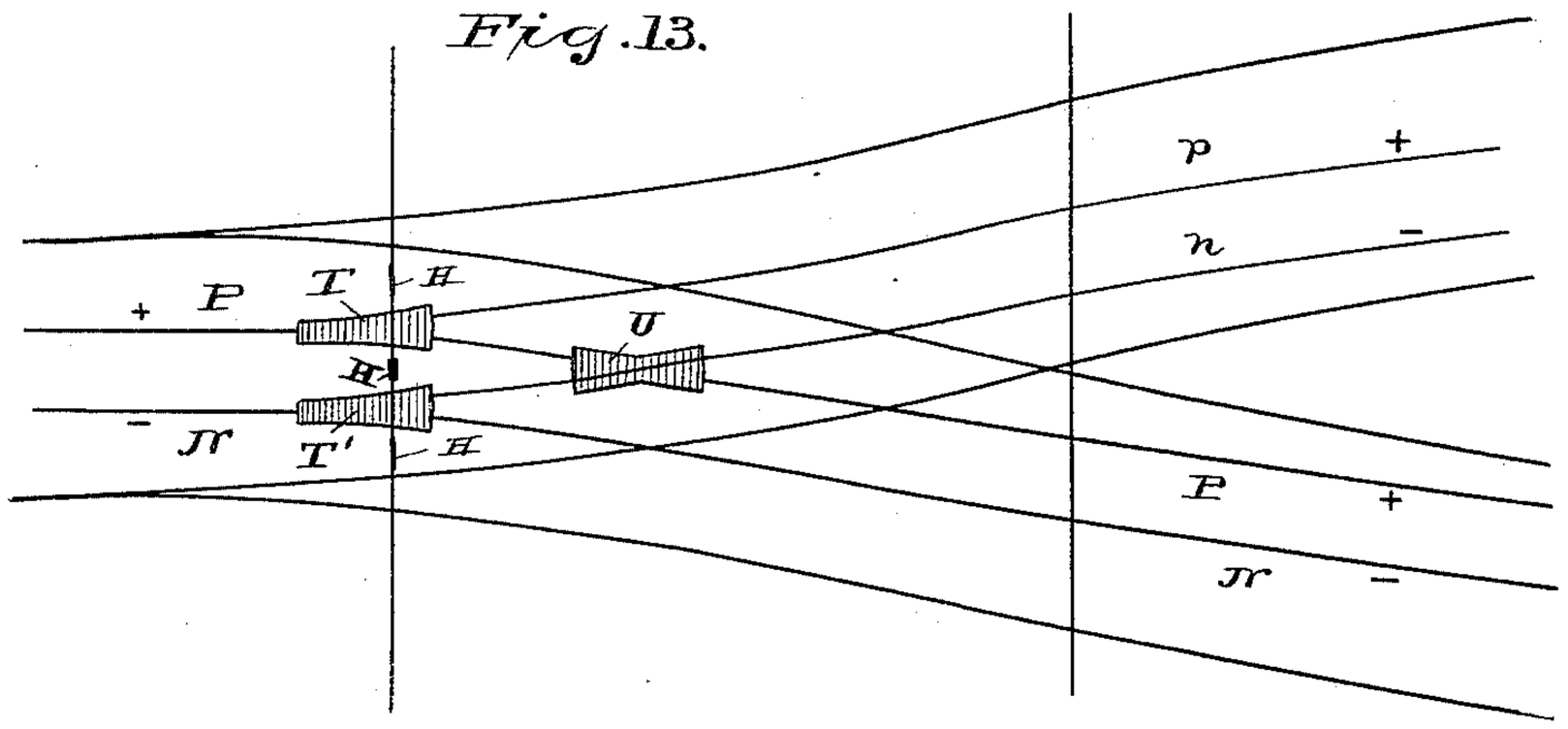


Fig. 14.

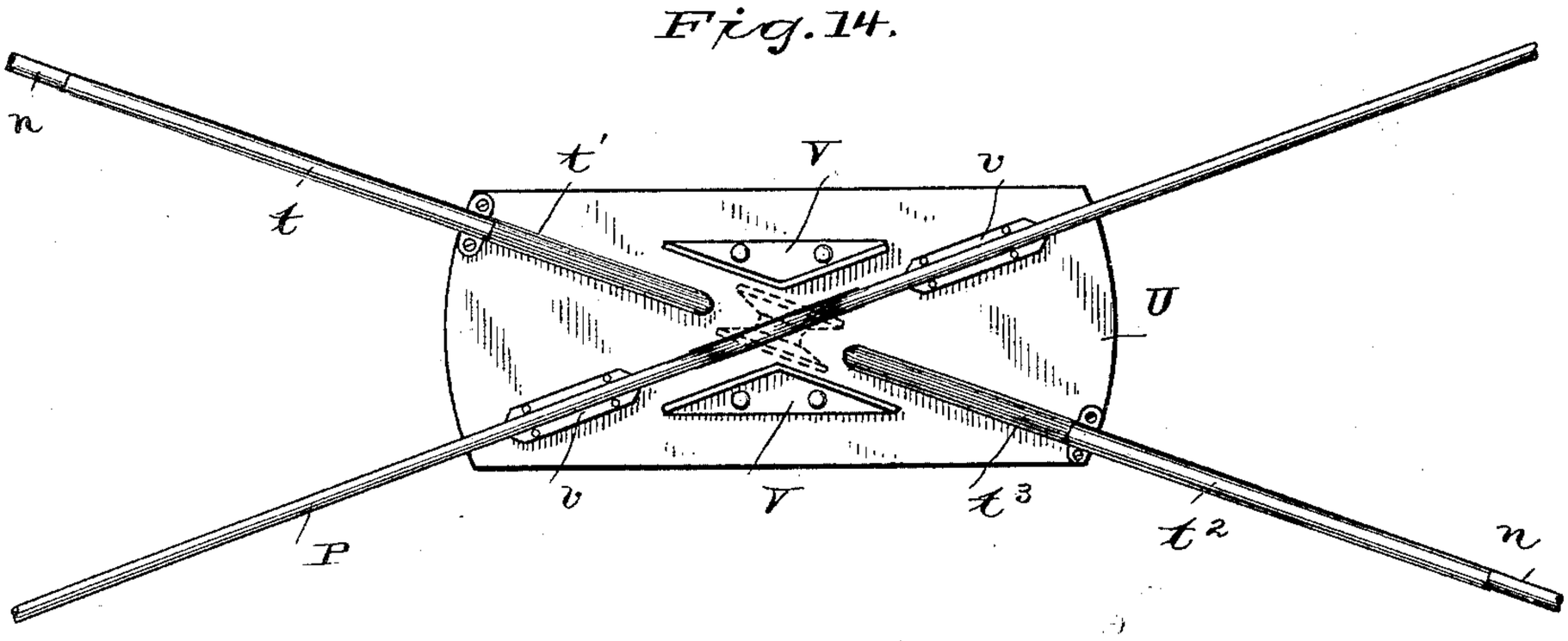


Fig. 15.

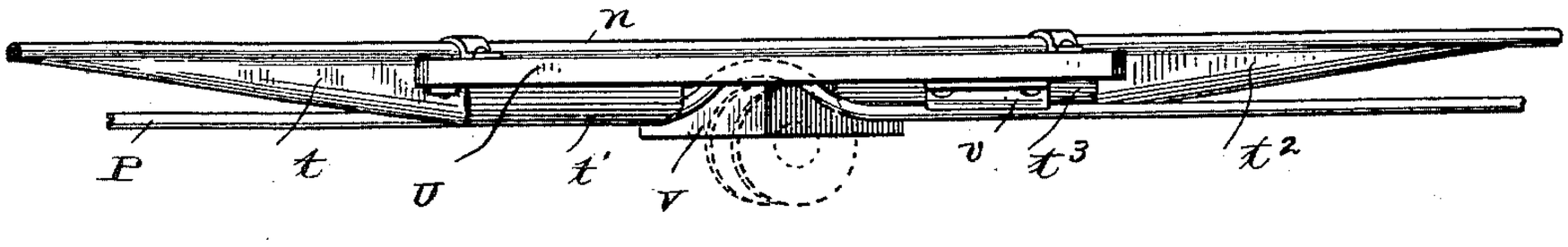
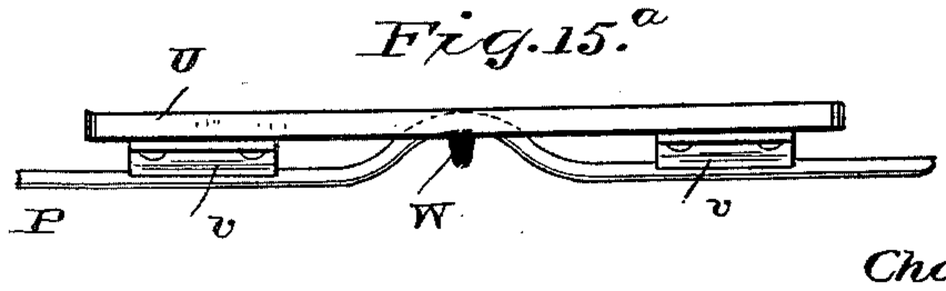


Fig. 15.a



Witnesses.

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C. L. Sturtevant.

Inventor.

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By Frankland James
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF LYNN, MASSACHUSETTS.

SYSTEM OF SUSPENDING ELECTRIC CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 394,039, dated December 4, 1888.

Application filed September 10, 1888. Serial No. 285,072. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Systems of Suspending Electric Conductors, of which the following is a description.

My invention relates to improvements in means for supporting the suspended supply-conductors used in what are called the "overhead supply systems of electric railways," to an improved arrangement and construction of said supporting devices, and to various other details of construction—such as insulators—the arrangement of switches and crossings, as will more fully appear, reference being had to the accompanying drawings, in which—

Figure 1 is a diagrammatic plan view showing the general arrangement of the overhead conductor and supporting devices. Fig. 2 is a similar view showing a part of the line including a turn-out. Fig. 3 illustrates the arrangement when crossing another similar line. Fig. 4 is an enlarged detail view of the crossing-switch. Fig. 5 is an enlarged detail of the turn-out switch. Fig. 6 is an enlarged end view of a portion of a single-track line. Fig. 7 is a side elevation on an enlarged scale, showing a portion of the main conductor and its suspending and anchorage devices. Fig. 8 is an end view of one of the arched suspending devices. Fig. 9 is a detail view showing a cross-wire or cable connection. Fig. 10 is a detail view of a link-insulator. Fig. 11 is a similar view of the link-insulator somewhat differently constructed. Fig. 12 is an elevation, partly in section, showing an insulating turn-buckle. Fig. 13 is a diagrammatic plan view at the end of a turn-out where double overhead conductors are used. Fig. 14 is an inverted plan view showing the construction at the point where supply-conductors of opposite polarities cross. Fig. 15 is a side elevation of what is shown in Fig. 14. Fig. 15ª is a detail showing a different form of guard.

Similar letters denote like parts throughout.

As seen in the drawings, A A′ A^2 A^3 A^4 represent the curb-lines of the streets along the line of travel of that portion of an electric railway illustrated in Fig. 1.

a a a′ a′ are the track-rails of a double line of railway extending along the street B and curving into the street C at right angles thereto.

P P′ are the main supply-conductors in circuit with the source of current and extending along the line of way at a height of about eighteen feet from the track and in a position substantially central thereabove.

The curved portions of the conductors P P′ are supported as follows: On the inside of the curve is located a pole, *d*, from which a stout wire or rope, E, extends along the street B to a pole, *e*, which may be at the next crossing or at any suitable intermediate point, the length of said rope after it passes fifteen or twenty feet from the crossing at which is located the pole *d* being immaterial. A second similar rope, E′, extends from the pole *d*, along the street C and is secured to a pole, *e′*, which may also for convenience carry a cross-wire, e^2, supporting a straight portion of the conductors. Poles F F′ are located at the adjacent crossings, preferably on the inside of the curbs A A^2, and connected by a cable, F^2, extending across the street beyond the outer limit of the curve. Cables G G′ extend from the poles F F′ to and are secured to poles *f f′*, which may be located opposite to the poles *e e′*, cross-wire e^2 being also secured to the pole *f*.

As indicated in the drawings, the line begins at the cross wire or cable f^2, secured to suitable poles, f^3 f^4, and to it the conductors P P′ are attached by insulating-links H, to be further specifically described, and adjacent to said links I provide turn-buckles I for adjusting the tension of the conductors. The straight portion of the conductors P P′ between the terminus and the curve is supported by cross-wires J J′, which are secured to the cables E G′. Said poles *e f′*, respectively being adjacent to the curve, must hold the conductors against considerable lateral strain. The cross-wire J′ includes strong metallic suspending devices K, to which the conductor is directly attached. These devices, which I have denominated "arched suspenders," are not herein claimed, being included in a separate application filed August 22, 1888, Serial No. 283,445.

The arched suspenders K are so constructed that the tension of the cross-wire is taken

through the line of the suspension of the conductor, and they therefore overcome all tendency to kick up and get in the way of the traveling contacts. A similar cross-wire, J′, is provided at the other extremity of the curve, and is shown as secured to cables E′ and G, although it may, if desired, be secured independently thereof. Any desired number of cross-wires *j* are secured to the cable F^2 on the outside of the curve, and extend to and are securely attached to the arched suspenders K K′, by which the curved portions of the conductors P P′ are supported.

I have only shown three of the cross-wires *j;* but it will be understood that for heavier or lighter or a greater or less number of main conductors or a longer curve the number of the cross-wires *j* will be increased or decreased, according to circumstances.

The cross-wires *j* are secured at their outer ends to cylindric insulators j^2, strung on the cable F^2, and held in desired position by suitable clamps, j^3. Insulating-links H are also preferably placed in the wires *j* near or at the point where they are united to the suspenders K.

Heretofore it has been found necessary in supporting conductors on curves to provide some means for maintaining the conductor in a practically curved position throughout the curve, necessitating the addition of rigid metallic bars and other devices. I find, however, that when my improved curve ear is employed no such auxiliaries are necessary, and the conductor can be safely suspended at intervals of several feet around the curve, the portions of conductor between the arched suspenders being substantially straight. Furthermore, the conductors being supported in the same plane as the cross-wire the contact device will pass around without disturbing or deflecting it.

The straight portions of the conductors P P′ are supported upon the cross-wires, as J e^2, suitable insulators, L, being secured to their supporting-ears and to the cross-wires. At the next desirable point of support for the straight portion of the conductor, which may be from one to several hundred feet from the curve, according to circumstances, are located poles L′ L^2 and a cross-wire, *l*, to which latter is secured a form of arched suspender, provided with anchorage-ears L^3. (Shown in elevation in Fig. 7.) The anchorage-ears L^3 constitute points of attachment for the anchorage-cables G^2 G^3, which extend from poles *e′ f* and are secured to said anchorage-ears. Thus it will be seen joining the straight portions of the conductors and the cables extending around both sides of the curve, firmly bracing, guying, and uniting the straight and curved portions of the overhead system. The remaining straight portions of conductor are supported by ordinary insulators, (shown in patents already granted to me,) suspended from the cross-wires except where the line is deflected, when the arched suspenders K are used, the point of suspension being then, as pointed out, in the same plane as the cross-wire. The anchorage-cables G^2 G^3 would be repeated upon the opposite end of the curve, but that the line, as shown, terminates at that point.

The arched suspender comprises a metal arch, M, provided with holes *m* in each extremity for the reception of the ends of the cross-wire or for attachment to an insulator, O, to which the cross-wires are then secured. From the lower central portion of the arch and arranged at right angles thereto is formed or attached the bail M′, seen in elevation in Fig. 7, but without the anchorage-lugs L^3. The bail M′ is tapered toward its extremities for lightness and in order to possess some flexibility under certain conditions, and is formed with a deep groove, M′, along its under side, in which groove the conductor P is permanently secured, desirably, by soldering, brazing, welding, or other equivalent means. The depth of the bail M′ is such that the conductor, when in place, will be in the same horizontal plane as the cross-wire, so that lateral pressure exerted against the conductor by the contact-wheel, even when in combination with the pressure of the wire due to a deflection from its straight course, will not elevate either end of the arch, and the conductor will consequently remain where placed.

The lugs L^3 (seen in Fig. 7) form points of attachment for the anchorage-cables heretofore referred to. It being desirable to form the suspenders M and the bails M′ in a single metal casting, the necessary insulation is provided by what I have called "link-insulators," which are placed in the cross-wires, as seen in Fig. 6, or attached directly to the suspenders themselves. Furthermore, I find it desirable to so construct one form of link-insulator that it shall combine the functions of an insulator and a turn-buckle, thereby admitting of the ready adjustment of the line while in use without any danger to the lineman.

A form of link-insulator is shown in Fig. 11 as consisting of a link or bar, Q, of wood or other equivalent material, about one foot in length and three-fourths of an inch in diameter, a desirable form having enlarged ends *q q*, strengthened by a metallic ferrule or sheath, *q′*, placed thereon and secured in position by a bolt or rivet passing through the ferrule and insulator. An aperture is formed through the ferrule and insulator for the reception of the cross-wire to which it is connected.

Another form of link-insulator is shown at Fig. 10, Q′ Q′ representing flat strips of vulcanized fiber or leatheroid, or even wood, which are at their ends firmly bolted to porcelain or other good insulating-washers, q^2, which are desirably grooved to receive the wires to which they are secured. For use as turn-buckle insulators the insulating end sec-

tions, q^2, are replaced by metallic parts q^3, through which pass the right-and-left screw-threaded rods Q^2 Q^2, to which the cross-wire is attached, and which, by rotating the turn-buckle in the usual manner, will be tightened or loosened at will.

In Figs. 7 and 9 is shown an improved wire-securing device consisting of a short tube or sleeve, L^4. When a connection is to be made, the sleeve L^4 is slipped upon the wire, the end of which is then passed through the point of attachment and the return bend brought back. The sleeve L^4 is then slipped or forced down over both wires and the end L^5 bent outward and cut off. By this arrangement a cross-wire can at any time be disconnected and again attached at the same point, which is not the case when the ordinary splice-joint is made, the numerous bends and twists of that form of connection rendering it impossible to open it without cracking or breaking the wire ordinarily used.

In Fig. 6 is seen a portion of a single-track railway with a turn-out to permit cars to pass. With this arrangement the suspended electric conductors are provided with switches or frogs R at points at each end of the turn-out adjacent to the intersections of the track, said switches operating to guide the contact-trolley onto the branch conductor. These switching devices are, however, described and claimed in other applications, No. 230,649, filed March 12, 1887, and No. 277,425, filed June 18, 1888, and shown for illustration only.

It will be observed that the frog R is placed near the point S and not at the point *r*, where the rails begin to diverge, the object being to avoid bringing the contact device into its switch until the car has sufficiently changed its direction to determine through which path in the switch-box the contact-wheel should pass. The suspended conductors are, with this arrangement, somewhat deflected toward each other away from the vertical central line of their respective tracks; but with appropriately-arranged contact devices—such, for instance, as described in my above-mentioned applications for Letters Patent—no inconvenience will result from such deflection.

It is obviously practicable to support the auxiliary cross-wires e^3 from separate poles or other supports provided therefor; but since the positions of the switches are liable to be altered and switches and turn-outs put in after a road has been completed the means here shown and described by me will be found extremely desirable. Furthermore, it is important to support the overhead system with a few poles, and consequently as little disfigurement and obstruction of the street as possible, to which end the main poles are placed at regular or convenient intervals without regard to switches or turn-outs, which are provided for as follows:

In order to give the desired support to the conductors between the extremities of the turn-out, and also to be able to deflect them into positions to secure the best and surest automatic operation of the switches R, cables N^2 N^3 are stretched between the poles N^4 N^5, at or near the ends of the turnout, and to these cables cross-wires e^3, including insulating-links H and arched suspenders K, are secured, and the main and branch conductors suspended therefrom, as indicated. Fig. 3 represents the point of intersection of two similar railways, a four-armed metallic switch-box, R′, having intersecting ways or channels *s s′*, (shown on enlarged scale in Fig. 4,) being provided for properly directing the course of the contact devices, one channel being in the line of conductor P′ and the other corresponding to the direction of conductor P^2. The crossing-switch R is supported by intersecting cables S' S^2, extending from poles placed at the four adjacent street-corners. The conductors P′ P^2 of the respective lines are arranged and secured in positions crossing each other on the top of the switch-box R′.

In Fig. 13 is represented part of the main track and one end of a turn-out in a single-track system of railway, in which both positive and negative suspending-conductors are employed, both the outgoing and return currents being supplied from the overhead conductors P N. With this arrangement two switches, T T′, are provided to enable branch conductors *p n* to be extended along the turn-out. A short distance in advance of the switches T T′ the negative branch conductor will cross the positive main conductor, and at that point I have shown a circuit-crossing, U. It is particularly desirable that the conductors crossing at the point U should not be severed, since in case it is desired to remove the turn-out the main conductor would, if severed at the crossing, have to be spliced at that point, and it will be readily understood that where the current is taken by a traveling contact with the wire splices or other rough or uneven places in the conductor are very undesirable. With this end in view I secure the negative conductor *n* across the top of the insulating-plate U. Along the under side of the plate U extend ribs $t\ t'\ t^2\ t^3$, the inner end portions, $t'\ t^3$, of which are of insulating material and their outer portions of conducting material, which is secured, desirably by soldering, to the under side of the negative conductor where it approaches and leaves the plate U. The ribs $t\ t^2$ serve to lower the contact-wheel in approaching the plate U and to guide it back to its conductor and convey current to the contact-roller, except along their inner ends. These ends being of insulating material the negative trolley receives no current while passing that point. It is, however, guided along the insulating end portions of said ribs, except at the central portion of the plate not traversed by said ribs. Triangular guards V V are placed on each side of the central portion of the plate and serve to guide the trolley when passing across the spaces between the inner end portions of the ribs $t'\ t^3$. The

positive main conductor P is attached at the under side of the plate U, thus crossing the negative conductor, and is supported at a short distance below the surface of said plate by metallic bails of about the depth of the groove in the contact-trolley. As shown, the conductor P passes diagonally across the plates and across the spaces between the extremities of the ribs, and in the spaces between the extremities of said ribs the conductor P is curved upward and desirably fitted into a groove in the said insulating-plate, so that the negative trolley can pass across it without touching. If desired, a small projection, W, of insulating material, may be placed at the central point of the depression of the conductor P, in which position it will engage the groove in either trolley and prevent lateral diversion thereof. This arrangement is shown in Fig. 15ª. The relative angles of the conductors crossing the plate U will obviously be varied to suit the positions in which it may be used.

Many details of construction, hereinbefore described, are specifically shown and referred to, but merely by way of illustration, since it will be understood that various minor modifications may be made without departing from the invention.

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

1. In a system of suspended electric conductors, the combination, with the curved portions of the conductor or conductors, of a cable extending across the outside of the curve, a plurality of supporting-wires extending from the cable to the conductors to be supported, and cross-wires, as J′, attached to and sustaining said conductors at or near the extremities of the curve, substantially as described.

2. In a system of suspended electric conductors, the combination, with the curved portions of the conductor or conductors, of a cable extending along the inside of the curve, a cable extending diagonally across the outer part of the curve, wires, as *j*, secured to the conductors and to the latter cable for sustaining the curve, and transverse supports secured to the two cables and provided with suspending devices attached to the conductors at or near the extremities of the curve, substantially as described.

3. In a system of suspended electric conductors, the combination of a cable extending along the inside of the curve and to a point along the straight track, a cable extending diagonally across the outer portion of the curve to a corresponding point on the opposite side of the straight track, curve-supporting transverse connections between the conductors and the outside cable, and anchorage-cables extending from the termini of the cables and attached to straight portions of the conductor, whereby the cables supporting the curved and the straight portions of the conductor are braced and connected, substantially as described.

4. In a system of suspended electric conductors, the combination of a pole at the innermost part of the curve, poles at right angles therefrom and adjacent to straight portions of the track, a cable connecting the poles, poles located exterior to the curve and substantially opposite to the extremes thereof, and poles located in line with said last-mentioned poles and opposite to poles along the straight part of the track, a cable extending between poles at the outer extremities of the curve and to the poles in line therewith, transverse supporting-wires extending between the outside cable and the curved conductors and secured thereto, transverse or cross wires secured to the cables and to the straight parts of the conductors at the extremities of the curve, and anchorage-cables connecting the end poles of the system to anchorage-bails secured to straight portions of the conductor, whereby the curve-supporting structure is mechanically united to the straight portions of the suspended system, substantially as described.

5. In a system of suspended electric conductors, the combination, with main and branch conductors at a turn-out, of suitable frogs or switches near its extremities, supporting-poles at or near said extremities, cables extending between the poles along the turn-out in the direction of the line of way, and transverse conductor-supporting wires connected to said cables, substantially as described.

6. In a system of suspended electric conductors, a crossing comprising two metallic channels following the direction of the crossing-conductors, said channels being in the form of a metallic frame or open-bottom box depending from the intersecting conductors at the point of intersection and in electrical connection therewith, substantially as described.

7. In a system of suspended electric conductors, a duplex turn-out comprising separate switches for the positive and negative main and branch conductors, and an insulating-crossing at the point of intersection of the branch negative and main positive conductors, substantially as described.

8. In a system of suspended electric conductors, a duplex turn-out comprising separate switches for the positive and negative conductors, and an insulating-crossing at the point of intersection of the branch negative and main positive conductor, comprising a plate of insulating material interposed between and supporting the positive and negative main conductors at the point of intersection, substantially as described.

9. In a system of suspended electric conductors, a crossing for conductors of opposite polarity, comprising a plate of insulating material secured to the under side of one of said

conductors, the other of said conductors being supported at the lower side of the plate and depressed below the surface thereof at the point of intersection, substantially as described.

10. In a system of suspended electric conductors, a crossing for conductors of opposite polarity, comprising a plate of insulating material, to the upper side of which one of said conductors—as the negative—is secured, metallic ribs secured to said conductor and extending to the under side of the plate, and provided with separated extremities of insulating material, bails secured to the under side of said plate for supporting the other conductor, and a recessed part at the point of intersection, into which a portion of the conductor crossing at the under side of the plate is depressed, substantially as described.

11. In a system of suspended electric conductors, a crossing for conductors of opposite polarity, comprising an insulated plate, upon the upper side of which the negative conductor is secured, ribs extending from the negative conductor near to the central portion of the under side of said plate in line with the said conductor, bails depending from the under side of said plate for attachment to the other conductor, a recessed portion at the point of intersection of said conductor, into which the lower conductor is depressed, and a guard or guards at the point of intersection for preventing diversion of the trolleys when crossing the open space between the depressed conductor and the ends of the ribs, substantially as described.

12. In a system of suspended electric conductors, a crossing for conductors of opposite polarity, comprising an insulated plate, upon the upper side of which the negative conductor is secured, ribs extending from the negative conductor near to the central portion of the underside of said plate in line with the said conductor, bails depending from the under side of said plate for attachment to the other conductor, a recessed portion at the point of intersection of said conductor, into which the lower conductor is depressed, and a guard or guards for preventing lateral diversion of the contact-trolley at the point of intersection of the conductor and ribs, substantially as described.

13. In a system of suspended electric conductors, the combination, with a portion of the main conductor deflected from a straight line, an arched metallic support therefor spanning said conductor and having its extremities in line therewith, and transverse supporting-wires for sustaining the same, substantially as described.

14. In a system of suspended electric conductors, a transverse support for suspending electric conductors, comprising a metallic arch, between the extremities of which the conductor is secured, supporting-wires secured to the extremities of the ear and to the poles or cables along the line of way, and link-insulators included in and forming part of the transverse supporting-wires, substantially as described.

15. In a system of suspended electric conductors, a supporting-wire having a loop or attachment to the parts to be sustained, said loop formed of a bent portion of the extremity of the wire, and a collar or sleeve encircling and uniting the main and return parts of the wire, substantially as described.

16. In a system of suspended electric conductors, the combination, with a supporting-wire and an ear or bail to which said wire is to be attached, of a collar or sleeve encircling and uniting the main and return bend of said wire, substantially as described.

17. A link-insulator having a longitudinal body piece or pieces of insulating material, and a re-enforcing washer or ferrule at either end adapted to receive the transverse supporting-wire, substantially as described.

18. A turn-buckle the body portion of which is composed of insulating material, substantially as described.

19. A turn-buckle formed of longitudinal side pieces of insulating material and having screw-threaded metallic ends attached thereto, and reversely screw-threaded rods engaging the metallic ends, substantially as described.

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

CHARLES J. VAN DEPOELE.

Witnesses:
FRANKLAND JANNUS,
FRANK T. OKELL.