(No Model.)

4 Sheets—Sheet 1.

A. S. KROTZ & W. P. ALLEN.

UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

No. 586,852. Patented July 20, 1897.

Fig. 1

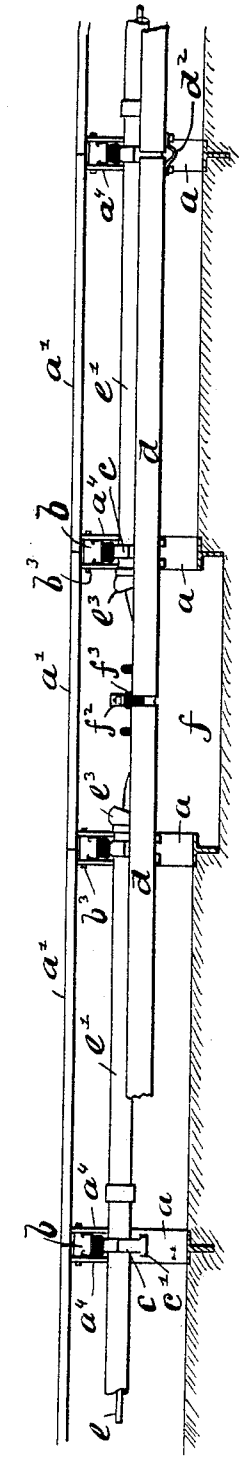


Fig. 4

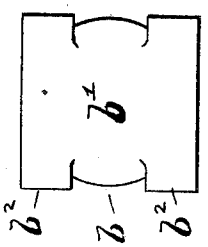


Fig. 2

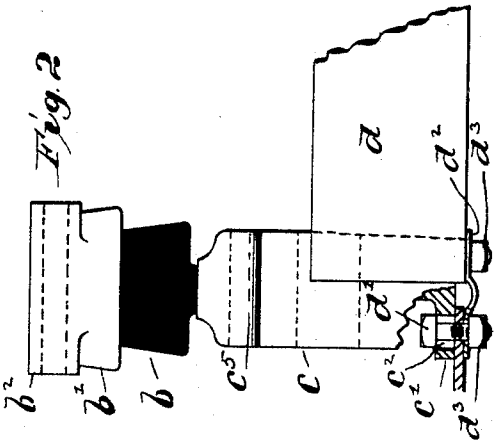
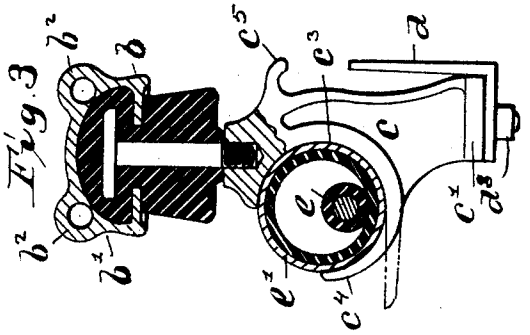


Fig. 3



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A. S. KROTZ & W. P. ALLEN.

UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

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Fig. 5

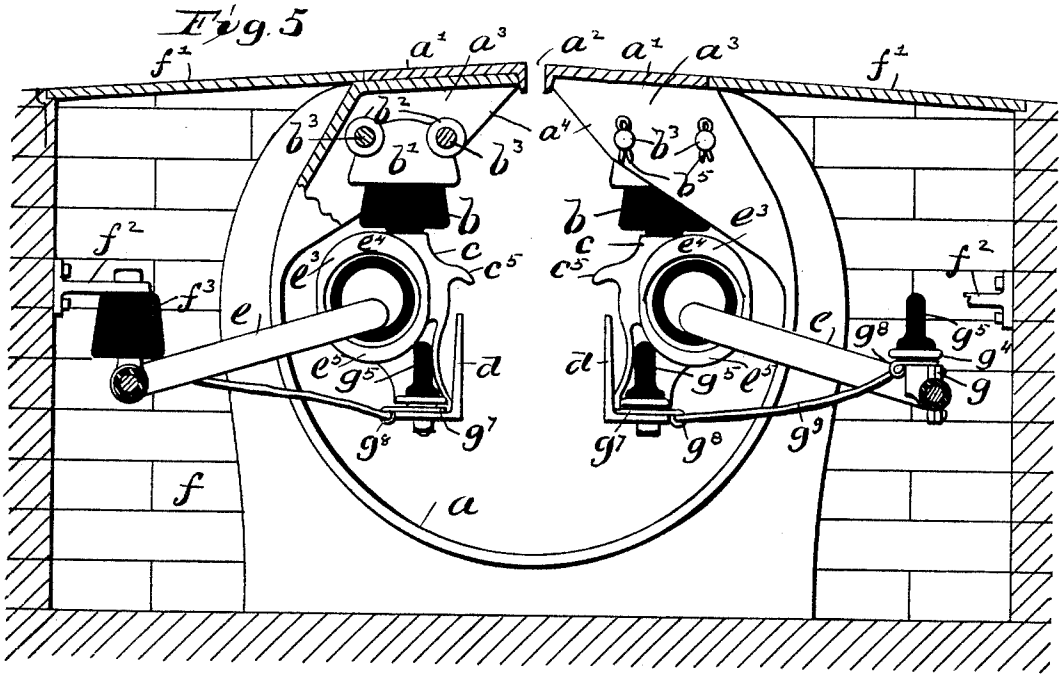
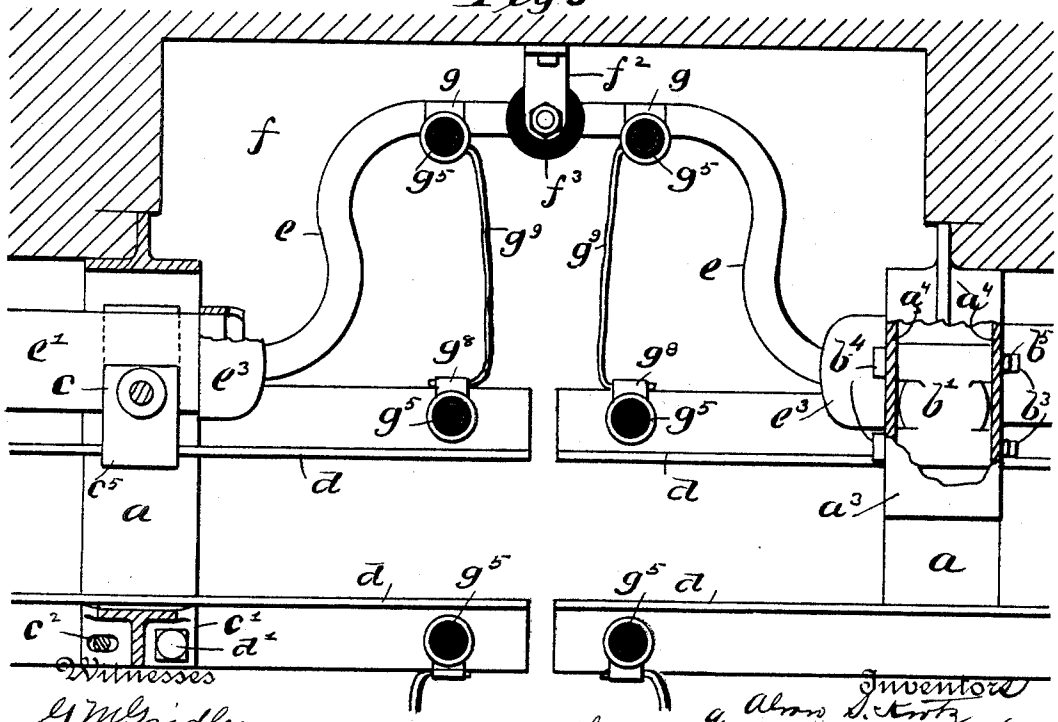


Fig. 6



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UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

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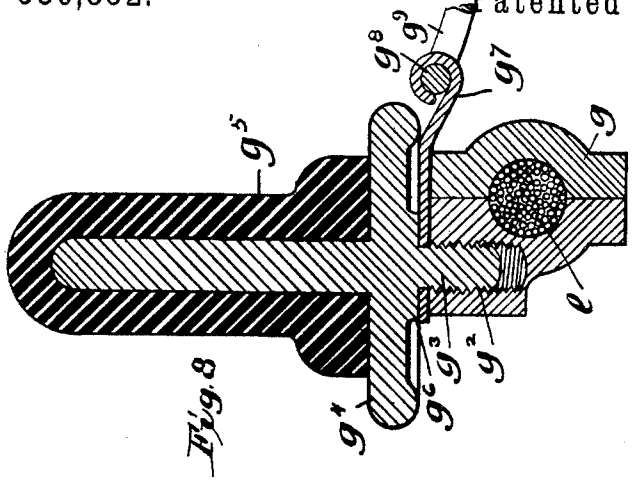

Fig. 8

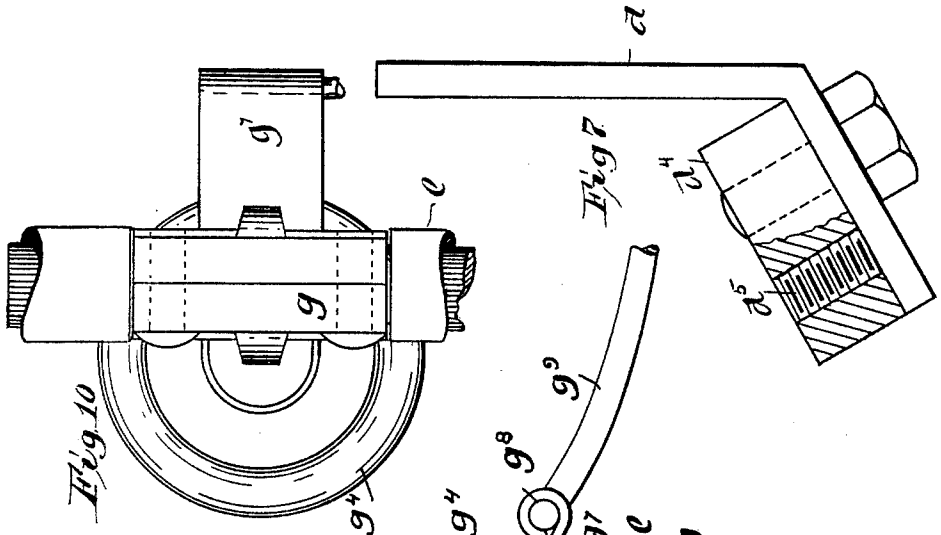

Fig. 7

Fig. 10

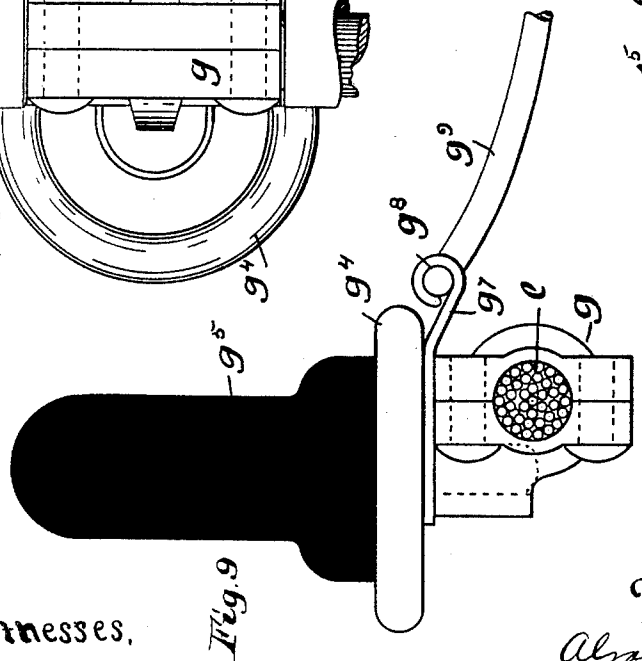

Fig. 9

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UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

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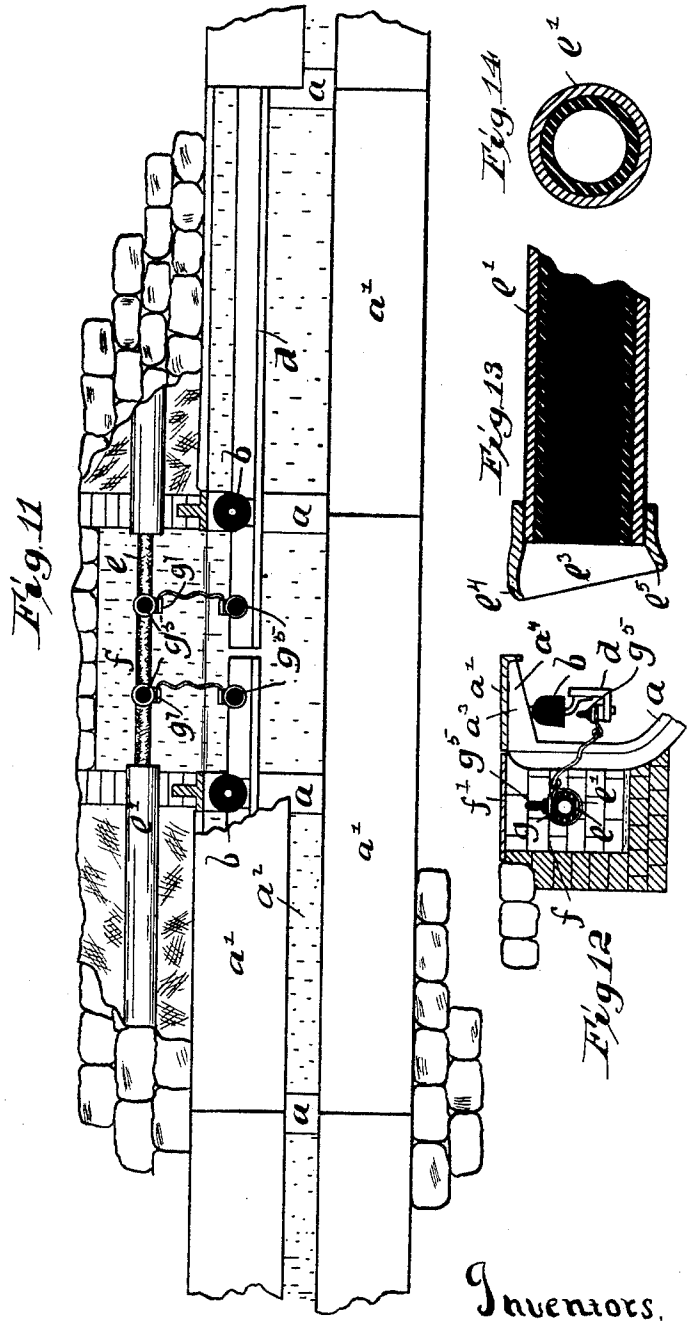

Fig. 11

Fig. 14

Fig. 13

Fig. 12

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UNITED STATES PATENT OFFICE.

ALVARO S. KROTZ, OF SPRINGFIELD, OHIO, AND WILLIAM P. ALLEN, OF CHICAGO, ILLINOIS, ASSIGNORS OF ONE-THIRD TO OLIVER S. KELLY, OF SPRINGFIELD, OHIO.

UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 586,852, dated July 20, 1897.

Application filed February 12, 1897. Serial No. 623,185. (No model.)

To all whom it may concern:

Be it known that we, ALVARO S. KROTZ, residing at Springfield, in the county of Clark and State of Ohio, and WILLIAM P. ALLEN, residing at Chicago, in the county of Cook and State of Illinois, citizens of the United States, have invented certain new and useful Improvements in Underground Systems for Electric Railways, of which the following is a specification.

Our invention relates to improvements in underground systems and devices connected therewith for transmitting electric current to moving collectors for use with railways and other similar purposes.

Our invention consists in the various constructions and combinations of parts hereinafter described, and set forth in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of a subway to which our improvements are shown applied. Fig. 2 is a detail view in elevation of the insulator and supports for the conductors and contacting rails. Fig. 3 is a partial sectional elevation of the same. Fig. 4 is a top view of the insulator. Fig. 5 is a vertical transverse sectional view in elevation of the subway at the enlarged chambers or manholes. Fig. 6 is a horizontal longitudinal sectional view of a portion of the same. Fig. 7 is a detail view of the contacting rail, showing a portion of the devices for making the electrical connections therewith. Figs. 8, 9, and 10 are detail views of the devices used for establishing a connection with said contacting rail from the main or feeding conductors. Fig. 11 is a plan view, partly in section, of the subway, showing a modification. Fig. 12 is a partial vertical transverse section of the same. Figs. 13 and 14 are respectively longitudinal and transverse sectional views of the pipes or casings in which the main feeding-conductors are supported.

Like parts are represented by similar letters of reference in the several views.

In the said drawings, a represents yokes or supports, which are placed at proper distances apart along the line of the subway. These yokes are adapted to form the supports for the various conductors and their connections, as well as for the plates a', which rest on the same at the top and form a cover for the subway and between which is located the slotted opening a^2, through which the connection is established from the moving collector in the conduit to the traveling car or other device.

The subway between the respective yokes a may be built up in any suitable manner with planks, masonry, concrete, or any similar material, the construction or material being immaterial, so long as the proper trench is provided.

The upper or overhanging portions a^3 of the yokes a are preferably reinforced by webs or ribs a^4, which extend inwardly and upwardly from the sides of the yokes to form braces or supports for said arms or overhanging portions a^3, and within these yokes and between the ribbed or webbed portions a^4 are placed insulators b, to which the hangers or conductor-supports c are connected. These insulators b are each preferably formed with a metallic cap b', which is provided on each side near the top with perforated sleeves or ears b^2, which are made of a length slightly less than the distance between the ribs a^4, so as to fit between said ribs. The ribs are perforated, so as to correspond with the perforations through these sleeves or lugs, and the insulators are supported in their proper positions by rods or bolts b^3, which extend through said ribs and said sleeves, these rods being preferably formed with heads b^4 at one end and perforated at the other to receive cotters or split keys b^5, as shown in Fig. 5, the construction being such that they may be readily removed or replaced for repairs or otherwise. The supports c, which are connected to said insulators, are preferably made of malleable metal and are each provided at the bottom with a foot c', having slotted openings c^2 therein, said support being further provided at one side with an open ring or sleeve c^3, in which the main or feeding conductors are supported.

The working conductors d are preferably formed of angle metal and are bolted or otherwise secured to the foot c' of the supports by fastening devices d', which pass through the slotted openings c^2 in said foot. These work-

ing conductors may be formed in sections of suitable lengths to extend over one or two insulators. They are preferably electrically connected together into longer sections by means of a flexible connecting-strip d^2, of copper or other similar material, which is fastened to said rails by the connecting devices d'. This is preferably accomplished by perforating the ends of the rail and screw-threading the same and having the fastening device d' formed in the nature of a bolt, screw-threaded and adapted to screw into the rail d, a nut d^3 being provided, by means of which the strip d^2 may be securely clamped to said rail, while the connection between the rail and the foot c' of the support is formed loose to permit of the coming and going of the rails d to compensate for the expansion or contraction thereof.

The main or feeding conductors e are preferably supported in metallic pipes or casings e', lined with an insulating material e^2, preferably wood. The feeding-conductors are also preferably formed in the nature of insulated cables, which are drawn through the pipes or casings e'. The pipes or casings e' are adapted to be supported in the open rings c^3 of the supports, and to provide for readily placing and securing said casings with their conductors in place we form the open ring or sleeve c^3 with a lip c^4, which normally stands at right angles to the axis of the support, as indicated by dotted lines in Fig. 3, but adapted to be bent up around the pipe or casing when the same is in place, so as to secure the same against accidental displacement. We also further provide the support c with an overhanging lug or lip c^5 just above and removed from the top of the working conductor d, to form a shield to protect the insulator b from arcing, which may take place between the working conductor and the traveling collector.

As before stated, the working conductors are preferably connected together into longer sections, and these are adapted to extend for any suitable length, but preferably terminate at an opening or chamber f, which is formed at the side of and communicates with the subway, being preferably located between two of the yokes a a and provided with removable covers f'. The pipes or casings e' for the main conductors e are also preferably formed in sections of a length adapted to extend from one chamber to the other, the lengths or sections, however, being slightly less than the lengths or sections of the working conductors, so that the ends of the casings stand substantially flush with or near the respective sides of said chambers, while the working conductors extend into the same, leaving only a short space between the ends thereof, over which the traveling collectors may readily pass. The connections between the feeding-conductors and the working conductors are established at these chambers, and in order to provide for a connection which may be readily removed or replaced if burned out and also to prevent arcing at the point of connection we deflect the main or feeding conductors laterally from the pipe-sections and support the same at the side of said chamber, preferably from a bracket f^2, secured therein, it being understood that the conductors e are continuous and extend entirely through all the lengths of the pipes or casings e'. This bracket f^2, which supports the laterally-deflected conductor e, is provided with a suitable insulator f^3, and on each side of said insulator the insulation is removed from the conductor e, and there is clamped thereto a two-part supporting-block g, having at one side a screw-threaded opening g^2, into which is adapted to be screwed a stud g^3, preferably provided with a flange or collar g^4, which extends laterally from the same. There is preferably formed on this stud g^3, above the collar g^4, a handle g^5, of rubber or other suitable insulating substance, and the flange g^4 is further preferably provided at the bottom with a shoulder g^6 around the stud g^3. Mounted upon the stud g^3 is a flat strip of copper or other suitable conducting material g^7, which is screw-threaded and screwed onto said stud, so as to rest against said shoulder, the screw-threads being removed from said stud at a point adjacent to the shoulder equal to the thickness of said strip g^7. The outer end of the strip g^7 is preferably formed into a sleeve g^8, into which is secured the end of a conductor g^9, which extends to a similar strip on a similar stud and handle. This conductor g^9 is adapted to form the connection between the feeding-conductor and the contacting rails and is preferably formed of fusible material to form a fuse connection. The connection between the conductor g^9 and the contacting rail is formed in a manner similar to that described. The stud g^3 is screwed into the rail, preferably at the horizontal portion, so as to clamp the strip g^7 between said rail and the collar or shoulder g^6. In case one of the connections g^9 should be burned out the studs are removed by unscrewing the same from the clamp and rail, respectively, which may be done by the insulating-handles without danger and new studs and connections substituted therefor. After the studs are removed the connections g^9 may be replaced and be ready to apply as a connection from the conductor, the construction being such that the strips g^7 may be readily unscrewed from the stud, the conductors g^9 placed therein, and the strips again screwed onto the stud ready for use. It will be seen that by this arrangement the points of connection between the main or feeding conductors and the working conductors is so far removed as to prevent arcing. At the same time the connection is such that they may be readily removed or replaced, as occasion requires, extra connections being preferably provided, so that it is only necessary to screw out the studs and screw new ones in their

place in order to repair a break or renew a connection.

To prevent moisture from entering the pipes or casings at the ends of the sections within the chambers *f*, we preferably provide the ends of said pipes or casings each with a hood or shield e^3, preferably in the nature of a sleeve, which is adapted to fit onto the end of said pipe and having an inwardly-curved top e^4 and an outwardly-curved bottom e^5, the top being preferably slightly longer than the bottom, so that the end of the pipe or casing is protected and any water or moisture deflected therefrom.

In Figs. 11 and 12 we have shown a modification. In this case the pipe or casing containing the feeding-conductors is placed at one side of the subway, but ends in the chamber *f*, as before. In this case the main or feeding conductor *e* may be extended straight, but the connections are established between the feeding-conductors and the contacting rails in the manner before described.

In Fig. 7 we have shown a slight modification of the working conductor *d*. In this case the bottom portion of the rail instead of being horizontal is formed at an angle, and there is secured thereto a metal block d^4, which is provided with a screw-threaded perforation d^5, in which the stud g^3 of the connecting device may be screwed to form the connection. If preferred, the ends of the working conductors, which project into the chambers, may have the bottom flanges inclined, as shown in Fig. 7, and provided with the blocks d^4, as such construction may facilitate the making of the connections.

It should be stated that the metallic casings for the feeding-conductors are supported loosely in the open rings or bearings on the supports *c*, and these casings are made in any suitable lengths, preferably screw-threaded, and connected together by the usual pipe-connecting devices, the lengths being preferably such as to bring the connecting devices between the length at the point between the yokes and supporting devices. This construction permits the casings to move slightly in their supporting-bearings to compensate for expansion and contraction by changes of temperature.

It will be seen that by the above constructions the outer metallic casings for the main conductors, as well as the working conductors, are formed in sections, which are independently connected to the main or feeding conductor. The main or feeding conductor being placed in the casing, which has a lining of insulating material, and being supported on the supports which are insulated from the yokes, is doubly insulated. If insulated cables are employed, then the insulation is still further perfected, so that all danger from loss by leakage from the main feeding-conductor is obviated. The working conductors being connected directly to the supports which also support the metallic casings, each section of the metallic casing and the corresponding section of the working conductor are in electrical connection, so that the casing forms an auxiliary conductor for the working conductors independent of the main or feeding conductors.

If desired, however, the working conductor may be insulated from the support, so as to be electrically independent of said support and of the metallic casing. The extended chambers in the line of the subway and the deflected main feeding-conductors, in connection with the devices before described, render all the connections of easy access and provide facilities for inspection or repairs for said connections of the simplest character, while the danger of loss from leakage is reduced to the minimum.

It is obvious that the devices herein described may be employed in a system in which a metallic circuit is used, two working conductors and their corresponding connections being employed, or it may be employed in a system in which a ground or track return is employed in which only one working conductor and its corresponding connections are employed.

When properly insulated main or feeding conductors are used, extending through the casings, the insulations in said casings may be dispensed with, if desired.

Having thus described our invention, we claim—

1. A subway having supporting-yokes, feeding-conductors and working conductors in said subway, said feeding-conductors and working conductors being supported on a common support, an insulator connected to said support, said insulator being removably secured to one of said yokes, said working conductors being formed in lengths electrically connected together by a flexible connection and loosely attached to said support substantially as specified.

2. The combination with a feeding-conductor and a contacting rail, a support common to both, an insulator to which said support is attached, and a lip or shield on said support and between said insulator and said contacting rail, substantially as and for the purpose specified.

3. The combination with the main feeding-conductor and a contacting rail, a support common to both, a foot on said support having a slotted opening, as described, a screw-threaded bolt extending through said slotted opening and engaging in a screw-threaded opening in said rail, a flexible connecting-piece threaded onto said bolt, and a nut on said bolt adapted to clamp said piece to said rail, substantially as specified.

4. A subway having the supporting-yokes with the overhanging portions reinforced by webs or ribs which extend inwardly and upwardly from the sides of the yokes as described, in combination with an insulator having a cap with lugs or sleeves adapted to

fit within said ribs, and removable pins extending through said ribs and sleeves, substantially as and for the purpose specified.

5. The combination with the contacting rails, a support therefor, an insulator secured to said support, a lip or shield on said support between said insulator and rail, a cap on said insulator having sleeves, yokes having depending ribs or lugs between which said sleeves are adapted to fit, and removable pins extending through said ribs and sleeves, substantially as specified.

6. In a subway having extended chambers at intervals therein, contacting rails and feeding-conductors extending through said subway, said feeding-conductors being supported in tubes or casings, the casings and contacting rails being formed in sections extending from one chamber to another, screw-threaded studs having insulated handles electrically connected together and connected respectively to said feeding-conductors and said contacting rails within said chambers, substantially as specified.

7. In a subway, the contacting rails and main feeding-conductors, said feeding-conductors being supported on common supports with said contacting rails, extended chambers in said subway extending across the line of said casings which extend from one chamber to another, the main feeding-conductors being deflected laterally from said casings in said chambers, independent supports for said conductors in said chambers, and independent connections from said conductors to the ends of the contacting rails which extend into said chambers, substantially as specified.

8. The combination with the feeding-conductors and contacting rails, of screw-threaded studs having insulated handles, and electrical conductors having perforated ends adapted to screw onto said studs, and means, substantially as described, for connecting said screw-threaded studs to the contacting rails and feeding-conductors respectively, substantially as specified.

9. An electrical connecting device consisting essentially of two or more screw-threaded studs having insulated handles, an electric conductor connected to each of said studs and provided with perforated ends adapted to screw onto said studs, and means substantially as described for connecting said studs to different metallic or conducting parts, substantially as specified.

10. The combination with a main conductor having attached thereto two-part clamping devices with a screw-threaded opening therein, a screw-threaded stud to fit in said opening having an insulated handle, and a conductor from said stud, said conductor being perforated and screwed onto said stud, substantially as specified.

11. A screw-threaded stud having an extended flange, and a reduced portion under said flange, an insulated handle on said stud and on the opposite side of said flange from the screw-threaded portion, a conductor having a perforated end adapted to screw onto said stud and rest in said reduced portion, and a connecting block or support having a screw-threaded opening into which said stud is adapted to be secured, substantially as and for the purpose specified.

12. The combination in a subway having a series of supporting-yokes and extended chambers arranged at intervals along the line of said subway, insulated supports suspended from said yokes, contacting rails and feeding-conductors on said supports, said feeding-conductors being supported in metallic casings formed in sections which extend between said extended chambers, said contacting rails being formed in lengths electrically connected together to form a section, the ends of which extend into the adjacent chambers, said main feeding-conductors being deflected at said extended chambers, and removable connections from said main feeding-conductor to the adjacent contacting rails in said extended chambers, substantially as specified.

13. In a subway having extended chambers as described, and the tubular casings formed in sections and extending from one of said chambers to another, a feeding-conductor extending through said casings, said casings being provided at the ends with hoods or shields, substantially as and for the purpose specified.

14. The combination with the main feeding-conductors and the casing therefor, of a hood or shield on the end of said casing, said hood or shield being formed with an inwardly-curved top and an outwardly-curved bottom, substantially as specified.

15. The combination with the main feeding-conductor and the casing therefor, a hood or shield on the end of said casing, said hood or shield being adapted to extend around said feeding-conductor and being provided with an inwardly-curved top and an outwardly-curved bottom, said top being adapted to overhang said bottom, substantially as specified.

16. An electrical connecting device consisting essentially of two or more studs having insulated handles and projecting flanges as described, an electrical conductor removably connected to each of said studs, and means, substantially as described, for attaching and detaching said studs to different metallic or conducting parts, substantially as specified.

In testimony whereof we have hereunto set our hands this 5th day of January, A. D. 1897.

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WILLIAM P. ALLEN.

Witnesses:
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