(No Model.) 2 Sheets—Sheet 1.

J. KRUESI.

ELECTRICAL CONDUCTING SYSTEM.

No. 322,385. Patented July 14, 1885.

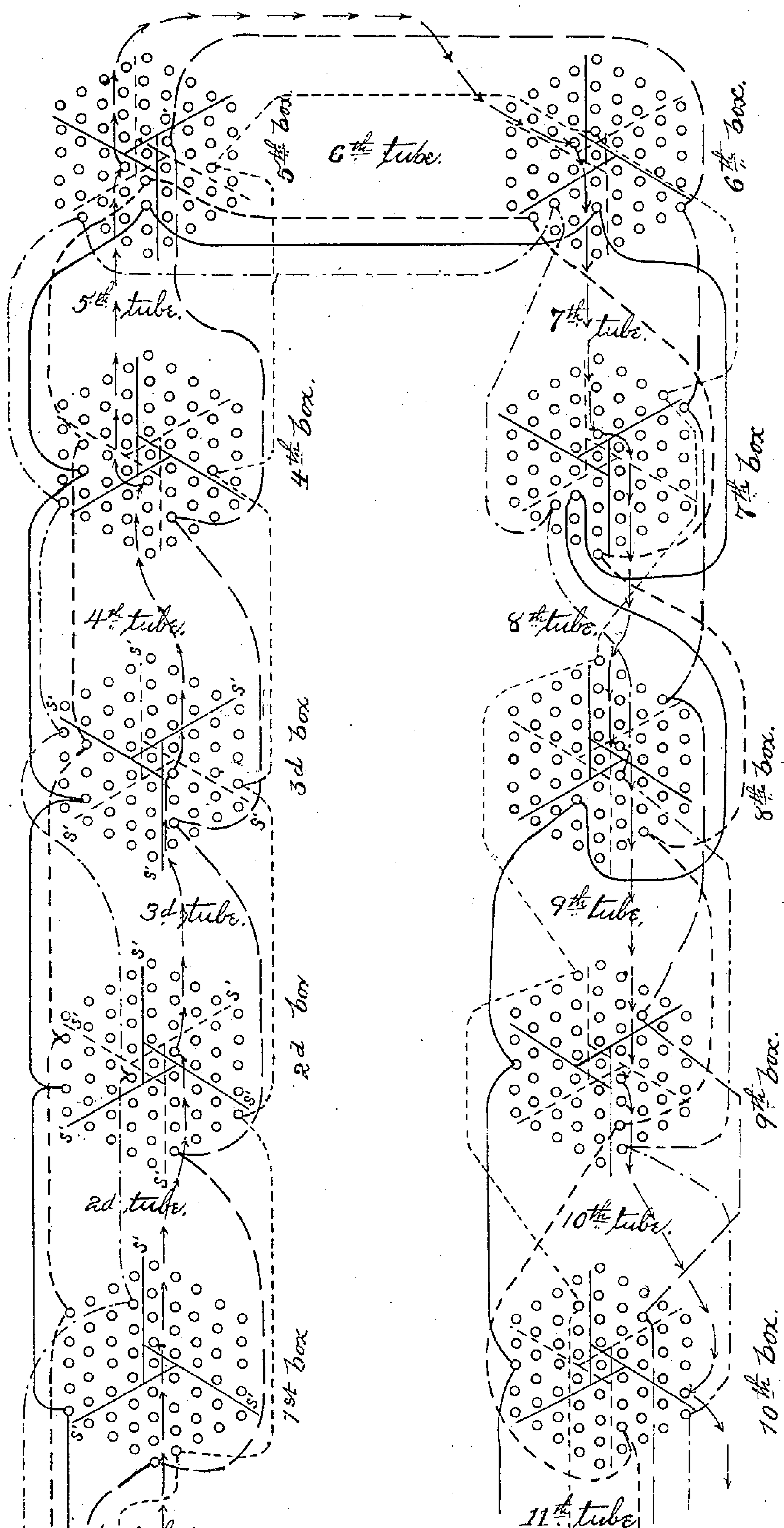

Fig. 1.

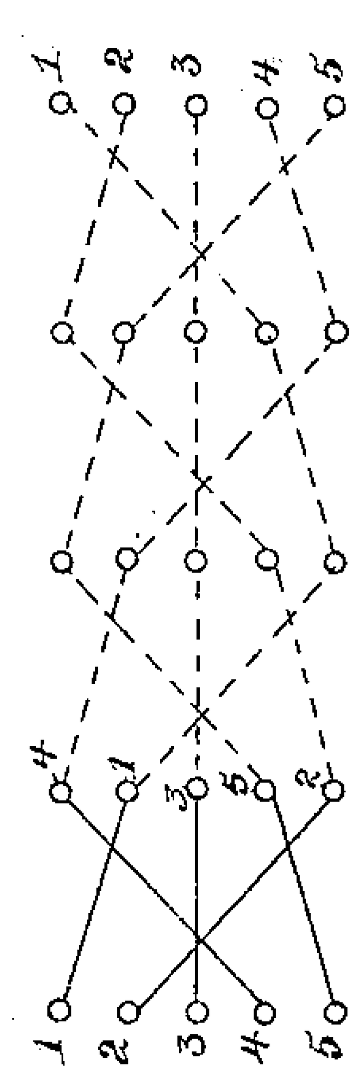

Fig. 2.

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Fig. 3.

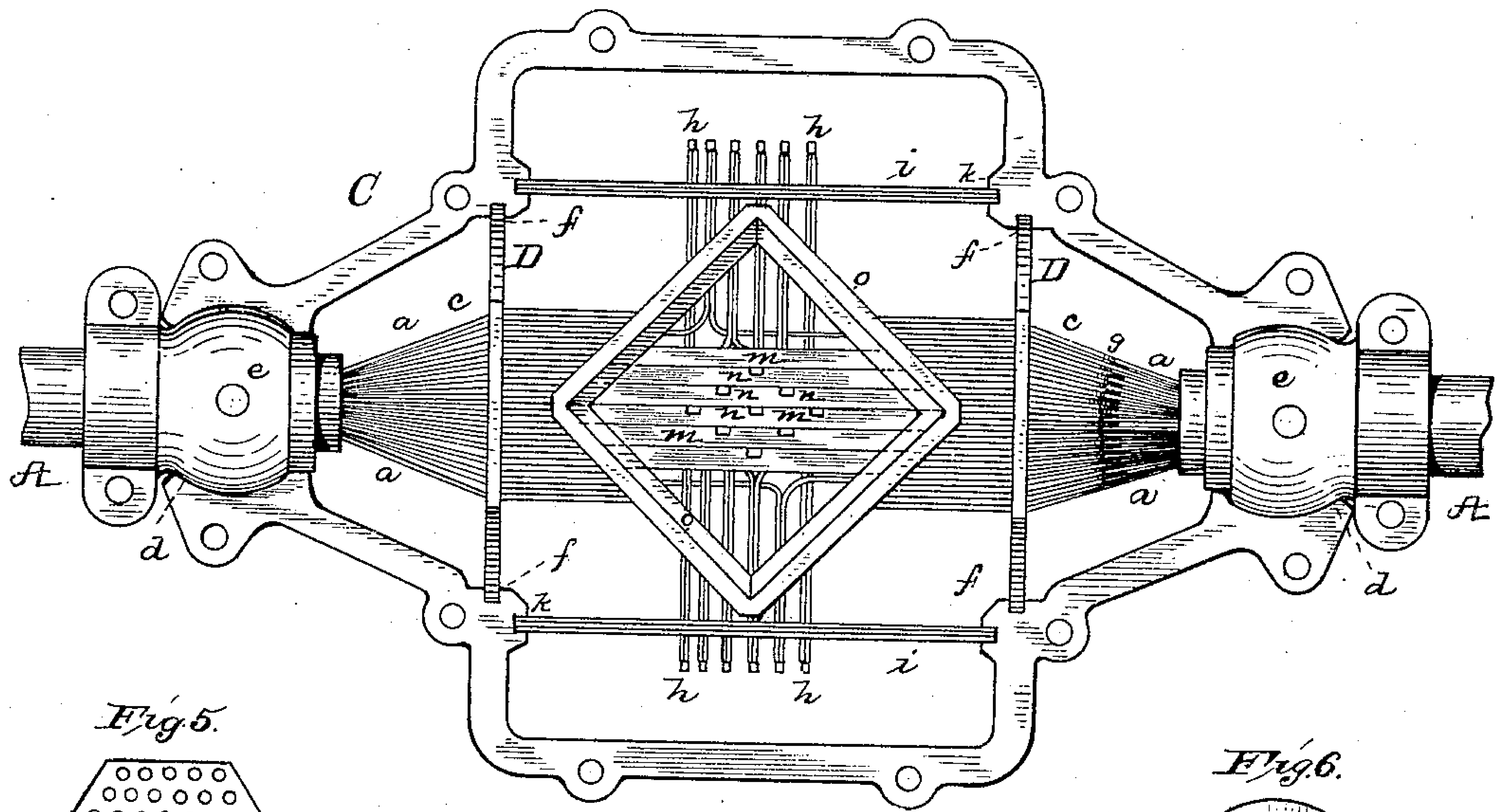


Fig. 5.

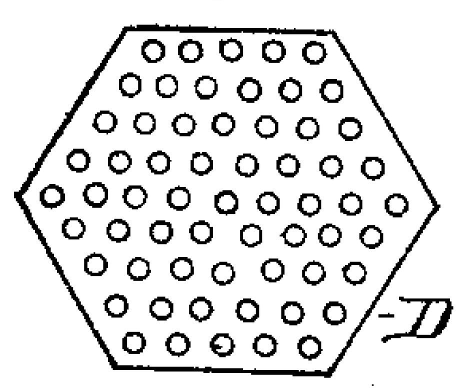


Fig. 6.

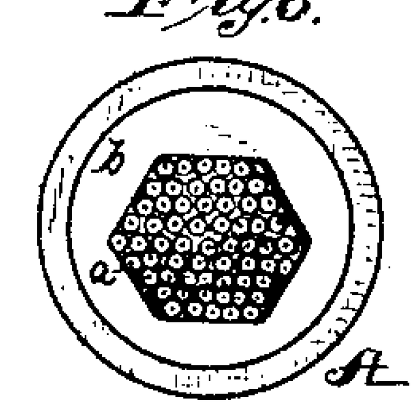


Fig. 4.

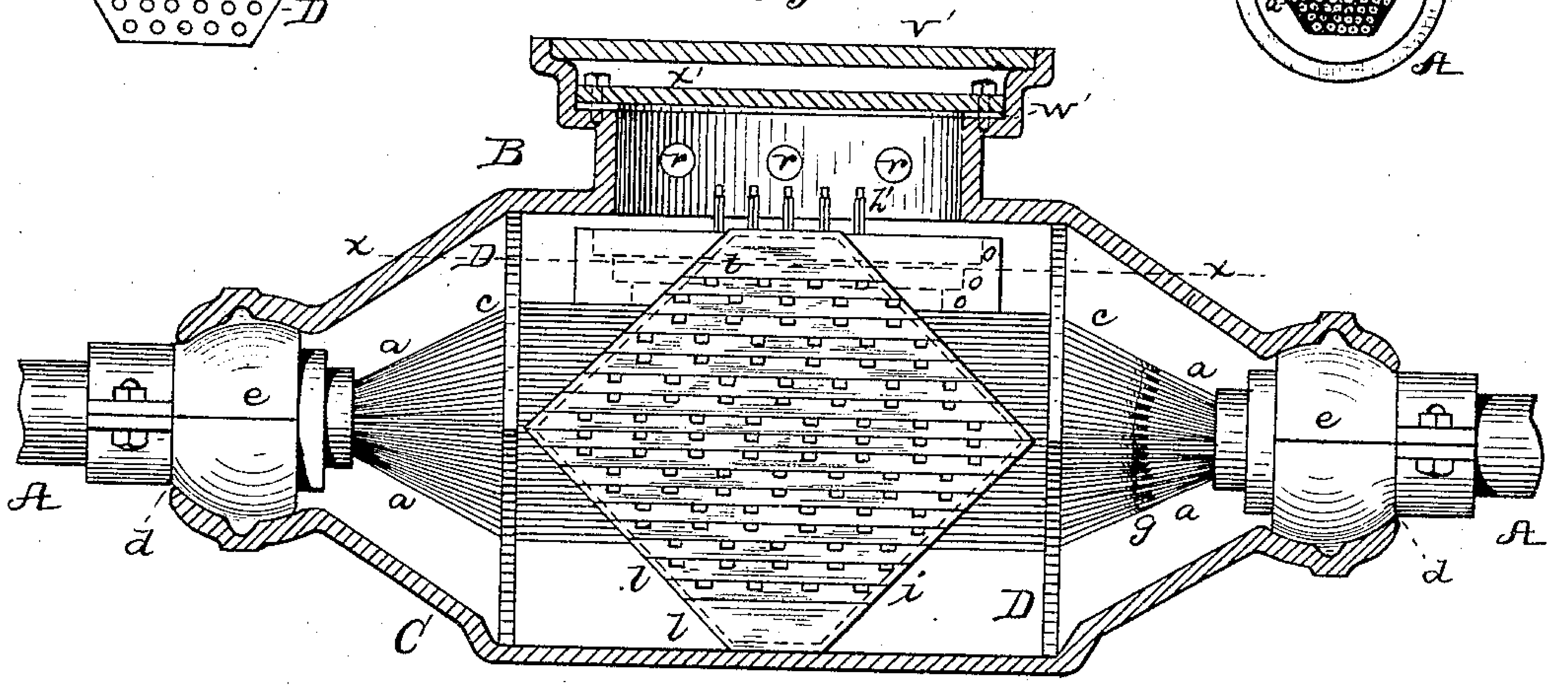


Fig. 7.

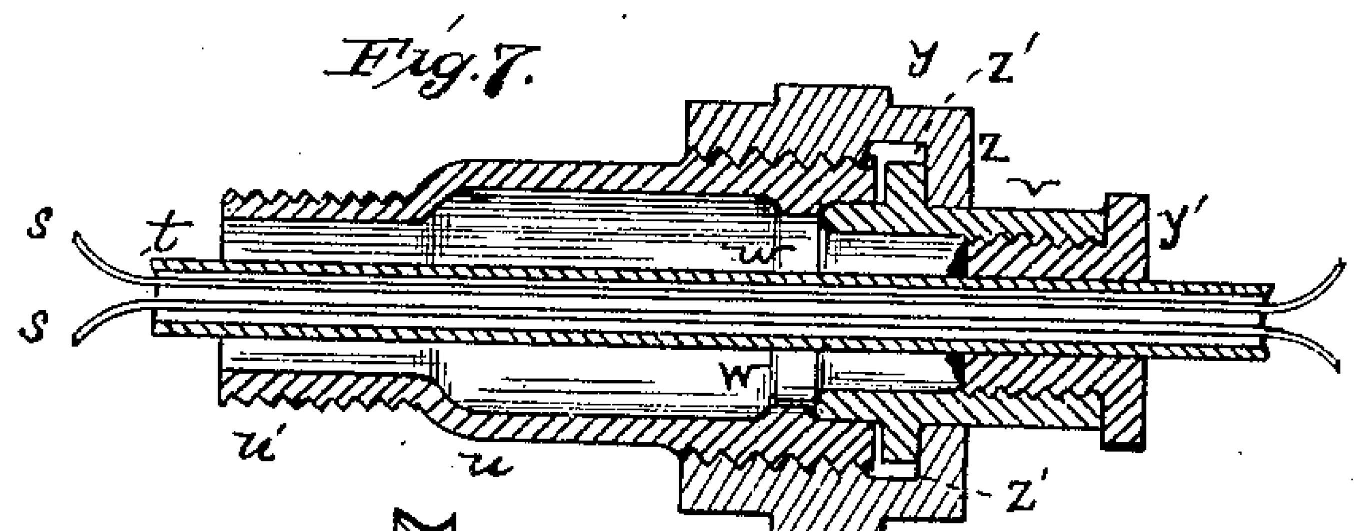
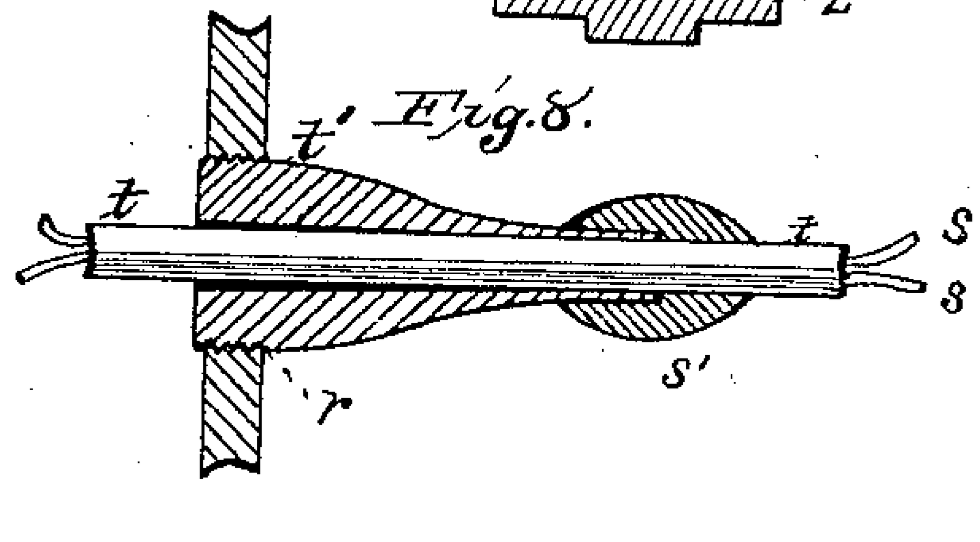


Fig. 8.



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UNITED STATES PATENT OFFICE.

JOHN KRUESI, OF BROOKLYN, NEW YORK.

ELECTRICAL CONDUCTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 322,385, dated July 14, 1885.

Application filed November 20, 1884. (No model.)

To all whom it may concern:

Be it known that I, JOHN KRUESI, of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Underground Electrical Conducting Systems, of which the following is a specification.

The object of this invention is to provide an economical and efficient system by which telegraph-wires or the wires of telephone systems may be laid underground, in which system, while the conductors are well insulated and well protected from moisture and other injurious influences, the separate conductors or branch circuits therefrom can readily be run off from the main collection of wires at a great number of points, and while a large number of conductors are laid close together, so as to occupy but little space, the effects of induction between such conductors shall be obviated; and my invention consists in the novel devices and arrangements employed by me in accomplishing the above-named objects, as hereinafter fully set forth and claimed.

In the accompanying drawings, Figures 1 and 2 are diagrams illustrating the mode of interweaving the conductors to neutralize induction. Fig. 3 is a plan view of the coupling and junction-box employed in my system, with the upper half of the box removed; Fig. 4, a longitudinal vertical section of the same box; Fig. 5, a view of one of the wire-supports within the box; Fig. 6, an end view of a tube containing the conductors, and Figs. 7 and 8 are sections of moisture-proof connecting devices for branch wires which may be employed.

In carrying my invention into effect, referring first to Figs. 3, 4, 5, 6, and 7, any suitable number of conductors *a a*, each of which is an insulated wire, and each of which is preferably the metallic portion of a ground-circuit, are massed together in iron tubes A A of a suitable size and length. A collection of wires somewhat longer than the section of tubing which is to contain them is drawn through a suitable die, preferably of hexagonal form, and so crowded into a hexagonal mass which is drawn through the tube-section, the number of wires being such as to nearly fill the tube, and the bundle of wires being first wound spirally with rope to hold it centrally in the tube. Wooden collars or plugs *b*, tightly inserted in the ends of the tubes and surrounding the wires, hold them in position longitudinally. The ends of the wires project from the tube, and are there separated or caused to diverge, though remaining in hexagonal form, as at *c c*. The ends of two adjoining tube sections are connected by means of a coupling-box, which consists of two longitudinal halves, an upper one, B, and a lower one, C. Tube-openings are provided at the ends of the box, each opening forming a spherical socket, and upon the tubes are clamped spheres or balls *e e*, which rest in the tube-openings, forming ball-and-socket joints, and permit the tubes to enter the box at a slight angle, either vertical or horizontal. This feature is set forth in my Patent No. 275,776, dated April 10, 1883. Near each end of the box is placed a hexagonal supporting-disk, D, the box having grooves or slots at *f f*, in which the disks are inserted and held upright. These disks have each a hexagonal series of apertures, as shown, in sufficient number to receive the wires to be supported by the disk. The wires entering the box at one end are twisted or interwoven within each box, as represented at *g*, according to a system which will be presently explained; and all the wires at both ends are then threaded through the holes in the supporting-disks and carried toward the middle of the box. Here each pair of meeting wires corresponding in position are bent out together at right angles toward the sides of the box, and the ends of the pair are connected together preferably by placing around them and soldering to them metal sleeves *h h*. Thus continuous conductors, extending through the box from one tube-section to the next, are formed.

The pairs of wires bent out toward the sides of the box are supported by the hexagonal disks *i i*, which are held in slots *k k*. These disks differ from the disks D, which are made in one piece, in being built up of grooved slats *l l*. The lowermost slat, *l*, being placed in position, the lowest layer of the paired wires is laid in the grooves in the upper side of the slat, and another slat is placed above them. It is evident that by thus bringing the wires out to the sides to connect them together such connections are much more readily and conveniently made than if it were attempted to connect the ends of a large number of wires all massed together in the middle of the box. Within each box, however, a certain number of wires h', instead of being brought out to the sides of the box, are bent up toward the top thereof, so that branch or service conductors can be taken off. In a telephone system in which a wire is run to each telephone only wires coming from one direction are bent up, and thus a certain number of lines end in each box, the successive tube-sections then containing lessening numbers of wires; or in a system in which telephones, signal-boxes, or other instruments are arranged in series the two meeting wires are brought up together and carried together to the respective terminals of the instrument; or wires from both directions may by my system be readily brought to the same instrument, whereby a subscriber may be connected to two stations in opposite directions from him.

As shown in the drawings, the ends of two wires are in each case brought up together, and two wires are shown in Figs. 7 and 8 as taken off together. However, the two wires may be left projecting, and a new subscriber connected to either or both of them, as desired, and, as stated, certain wires are so left in each box. To separate and support these upright wires, the insulating-strips m m are laid horizontally, the wires passing through the grooves n in these strips, and such strips are held in position by the square frames o o', placed above them. These frames are of such thickness that the topmost one comes in contact with the flange p on the under side of the upper half of the box. From the ends of the wires h' wires are taken off, as has been just explained, at such points as desired along the line, such wires passing through the holes r r in the upper half of the box. A sufficient number of wires are brought up at each box to meet any future demands for branch wires or connections which are likely to arise.

After the wires have been arranged in the box as above described, the box is filled to about the point indicated by the dotted line x x with a fusible insulating material in a liquid state, which becomes solid when it cools, such as an asphaltum compound. The ends of the wires h' h' project above the insulating material, so that connections to them can be readily made. In making such connections the branch wires s s, preferably incased in a lead tube, t, have their ends soldered to the ends of two of the wires h', and the lead-covered wires are then passed through the aperture r, which is closed moisture-tight by a device such as is shown in Fig. 7 or in Fig. 8.

In Fig. 7 the lead-covered wires pass through a sleeve, u, whose screw-threaded end u' is screwed into the aperture. Sleeve v is then inserted in the larger end of u, bearing against the internal flange, w, and this is surrounded by the external sleeve, y, whose shoulder z bears against shoulder z' of sleeve v. The whole is then secured tightly together by the flanged screw-threaded plug y', and a moisture-tight joint is thus formed

The device shown in Fig. 8 is in some cases preferred. In this the wires are surrounded by a tube, t', of brass or other metal, whose larger end is screwed into the aperture, the tube tapering, as shown, toward its outer end, and here it is fastened to the lead tube t by a wiped joint—that is, by the mass of solder, s'. This also provides a moisture-tight junction. After the box is filled with insulation, the inner cover, x', is bolted to the box, as shown, a rubber gasket, w', being placed between the box and cover to make the joint moisture-tight. The outer cover v' is then placed in position, after which the trench in which the tubes and boxes are laid may be filled up.

To destroy or neutralize the inductive action between the numerous wires of the system, I have devised a method of interweaving the wires in the boxes, so that in no two successive tubes will the wires in the bundle have the same relative positions—that is, for no more than the length of a tube-section, which is preferably twenty feet. This mode of interweaving is illustrated diagrammatically in Figs. 1 and 2.

The hexagons in Fig. 1 each represent one of the hexagonal supporting-disks in a junction-box, while the tubes are supposed to be located in the spaces between them. The course of six wires through eleven sections of tubing is indicated, each wire being represented by a different kind of line.

In preparing the sections of tubing, the first disk of each box is divided, or supposed to be divided, by lines r' r' into three equal parallelograms, the central hole being outside of all three. Suppose five wires, after passing through the first tube, enter respectively the five holes of the top row of the first hexagon of the first coupling-box. As indicated in Fig. 2, the wires before they reach the first hexagon of the second box—that is, at the point g, Figs. 3 and 4, of the box—are interwoven, so that the first wire (No. 1) enters the second hole in the corresponding row of the second box hexagon, the second enters the last hole, the third the third hole, the fourth the first hole, and the fifth the fourth hole. If, as indicated by the dotted lines in Fig. 2, the same system of interweaving were continued in box after box, the position of the wires would change for four tubes, but they would then return and pass through a tube in the same position as at first. This, therefore, does not give a sufficient number of changes, and hence I have adopted the system shown in Fig. 1.

The parallelograms or "diamonds" into which each hexagon is divided are each composed of four rows, each row containing five holes. The wires passing through the five holes of the first row of any diamond may be interwoven, as in Fig. 2; but to give a greater variety of changes the hexagons are successively given a sixth-turn in either direction, so that a diamond of different position relative to the angles of the hexagon is brought into position at each box, or the diamonds "break joints," so to speak. Take the second hexagon, for example. Here the diamonds into which the hexagon is divided are shown in full lines, while those which would be brought into corresponding positions by giving it a sixth-turn, or, in other words, the corresponding diamonds of the next disk are indicated by dotted lines. This may be better understood by following the course of one of the wires—that shown in full line, for example. In the first box or first hexagon this is in the first hole of the first row of the upper diamond. In the next hexagon it is changed according to the plan of Fig. 2, so that it is brought to the second hole of the same row, it being evidently unnecessary to change the position of the diamonds for the first interweaving. If the next hexagon were not turned, this wire would now pass to the last hole of the same row; but the change in position of the hexagon brings the wire into another diamond, indicated by the dotted dividing-lines in the second and the full ones in the third hexagon, and in this diamond it is in the last hole of the second row, counting always from the left, and it is therefore brought—still following the plan of Fig. 2—to the fourth hole of the same row of the third hexagon; but this is the first hole of the second row of the dotted diamond, (third hexagon,) or of the full diamond in fourth hexagon, and so in the latter it is brought to the second hole in the second row, which is the fourth hole, third row, of the dotted diamond, and brings the wire to the first hole, third row, full diamond of fifth hexagon. This is the third hole of the third row of the dotted diamond of the fifth and full diamond of the sixth hexagon, and as the third wire does not change it comes to the same hole in sixth hexagon. It is unnecessary to change the middle wire, as those on all sides of it are changed. Being now in the first hole of the third row, dotted diamond, of the sixth hexagon, it comes to the second hole, same row, full diamond of the seventh, which is the middle hole of the last row of the dotted diamond, and therefore brings it to the same hole of the eighth. This is the second of a dotted-diamond row, so the wire goes to the last of same row, ninth hexagon, which is the middle hole of the dotted-diamond row, and brings the wire to the same hole in the tenth hexagon. The wire has thus constantly changed its position, and at the same time all the wires have, as represented, changed theirs, and the wires may thus be run an enormous distance without the wires in the bundle ever resuming their original relative positions, whereby the induction between the wires cannot be set up to any injurious extent.

The particular plan of changing the wires between the holes of corresponding rows (shown in Fig. 2) is evidently not the only one which can be employed. Any symmetrical or systematic plan may be used, though that which furnishes the greatest number of changes is evidently preferable. Of course, with disks employing a greater or less number of holes a different plan must be adopted; but the system of breaking joints by turning the hexagons is, it is evident, applicable in all cases. The hexagonal form for massing the wires is advantageous not only in permitting the employment of this system of mixing or interweaving the wires, but because the wires can thus be placed in smaller compass and more closely packed together than in any other form. Branch wires are readily taken off at every twenty feet, or less if it is desirable to make the tubes shorter. Thus the system is especially applicable for telephone-lines, a large number of lines being laid and several wires being left projecting above the insulation at each box, so that when it is desired to make connections for new subscribers they can always be readily made at a point close to that of the service desired, and by branching off the ends of two meeting wires, as shown, the subscriber can be connected upon the line in both directions at once.

The system is very readily put into use. Each tube-section may be prepared at the shop, with the ends of the wires projecting from it at each end and passed through the supporting-disks, being previously interwoven at one end, and the tubes may then be laid in the boxes and the wires brought out at both sides and to the top, and there connected. By bending the wires out in two directions, only half the mass of wires is encountered at one time in making connections, and the ends of all these wires are separated by passing through the supports, and are in convenient position for joining, instead of being all together in one mass in the center of the tube, as heretofore, where it is exceedingly difficult to reach and handle the wires in the center of the closely-packed bunch.

In consequence of the well-protected situation of the wires and of those for branch connection being all separate from the rest and above the insulation, the mass of wires will ordinarily never have to be disturbed.

What I claim is—

1. The combination of separate sections of tubing, each inclosing a group of wires, coupling-boxes joining said sections, within which boxes the wires are bent laterally and caused to diverge, and separating-supports for holding the ends of said laterally-bent wires apart, substantially as set forth.

2. The combination of sections of tubing, each inclosing a group of wires, coupling-boxes joining such sections, within which the wires are bent laterally for connection, separating-supports for the wires where they enter the box, and separating-supports for the laterally-bent ends, substantially as set forth.

3. In an underground electrical conducting system, a series of tubes, each inclosing a

number of wires massed closely together in regular hexagonal form, in combination with coupling-boxes connecting said tubes, within which the wires are interwoven, substantially in the manner described, and the wires of the two tubes are connected together, substantially as set forth.

4. The combination of the hexagonal mass of wires and the supports, each having a hexagonal group of apertures, said wires being interwoven from row to row of the hexagons, and each succeeding hexagon being given a sixth-turn, as described, substantially as set forth.

This specification signed and witnessed this 1st day of November, 1884.

JOHN KRUESI.

Witnesses:

CHARLES BUZZER,

JOHN LANGTON, Jr.