July 23, 1940. H. C. DANIELS 2,209,152

PLURAL ELECTRIC CONDUCTOR

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Fig. 1.

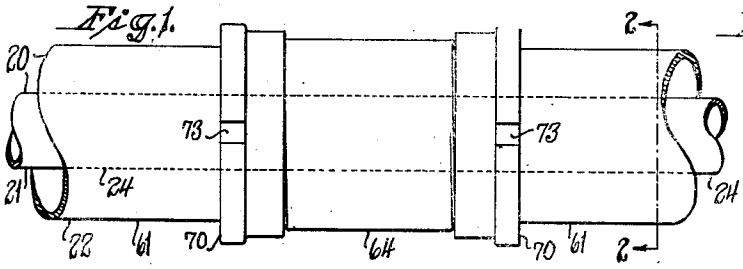

Fig. 2.

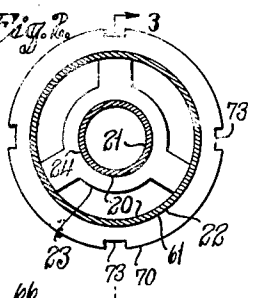

Fig. 3.

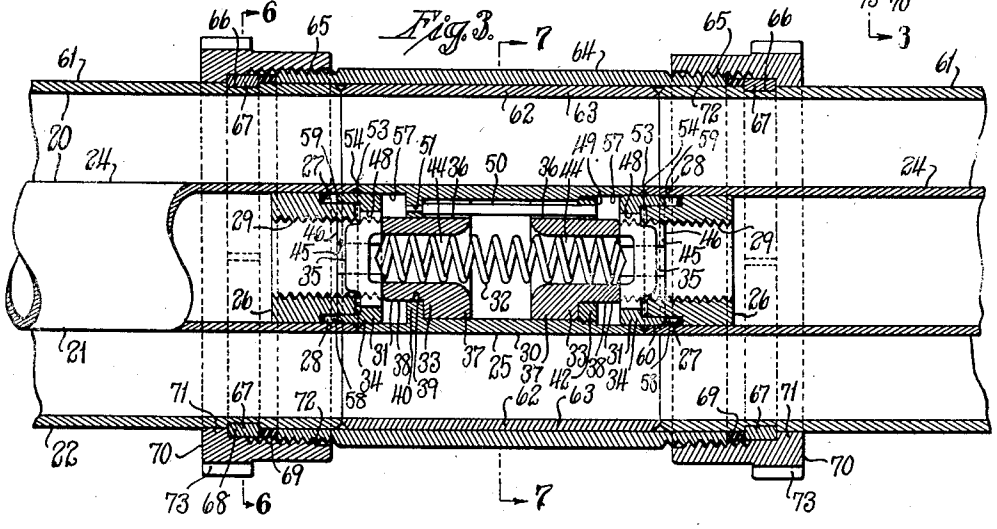

Fig. 4.

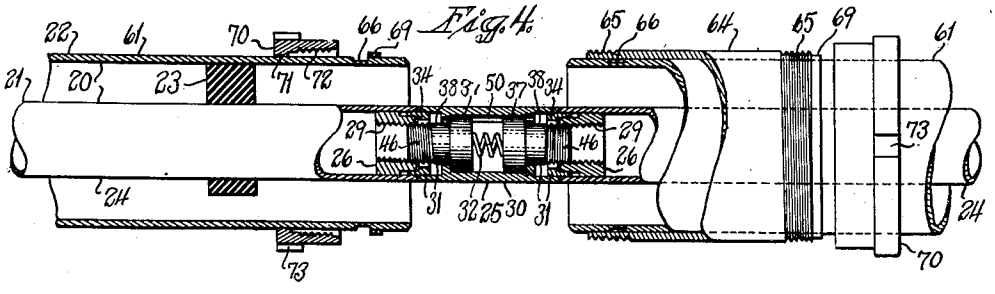

Fig. 5.

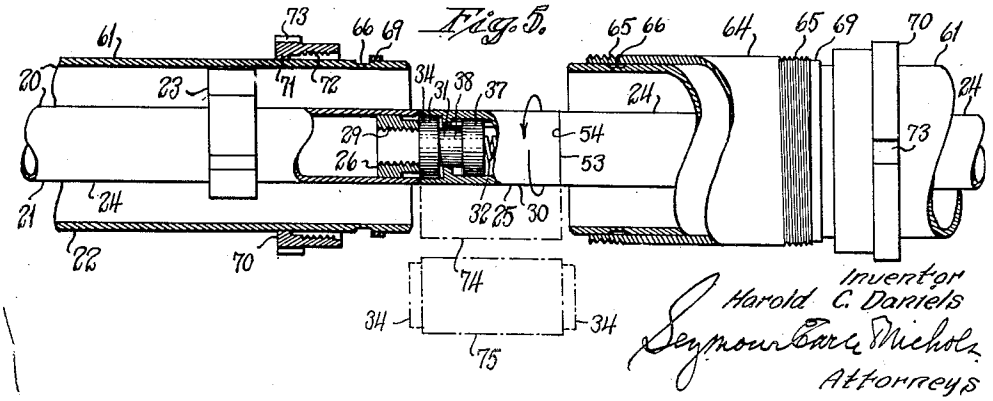

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Fig. 6.

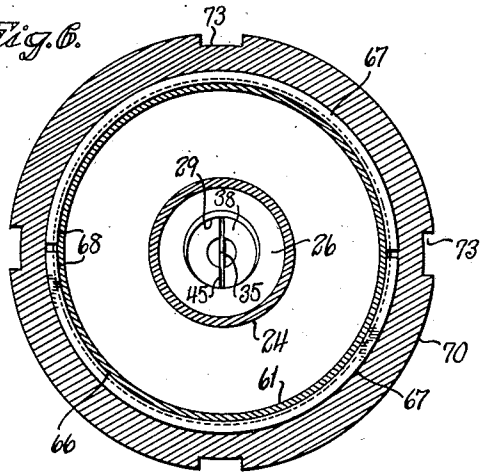


Fig. 7.

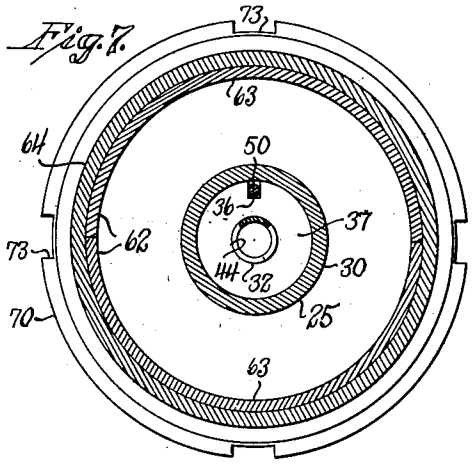


Fig. 8.

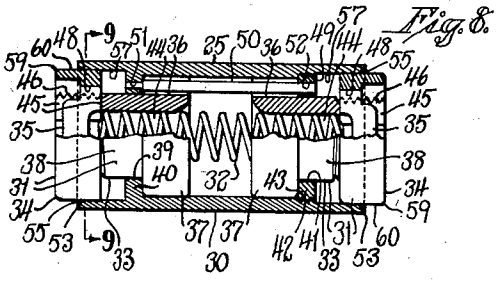


Fig. 9.

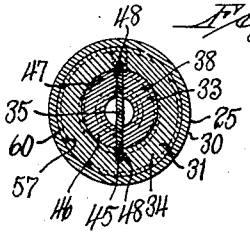


Fig. 14.

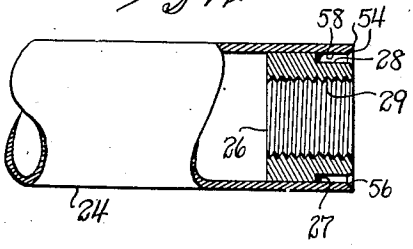


Fig. 10.

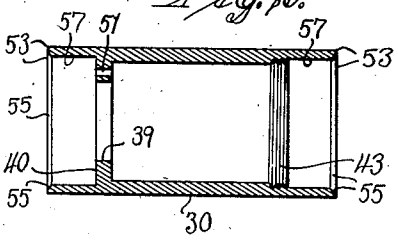


Fig. 13.

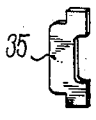


Fig. 12.

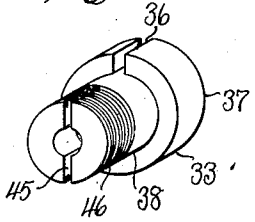
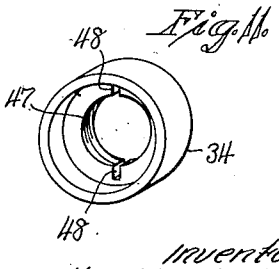


Fig. 11.



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2,209,152

UNITED STATES PATENT OFFICE

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PLURAL ELECTRIC CONDUCTOR

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Application September 26, 1938, Serial No. 231,654

6 Claims. (Cl. 174—88)

This invention relates to improvements in plural electric conductors in which one conductor is located inside of the other. It is particularly useful for interconnecting the power-output tubes of a radio or television station with the antennae.

Conductors of the general nature here involved generally consist of two substantially-rigid tubular conductors, one within and substantially coaxial with the other, and each formed of a plurality of sections connected together to form the two tubular conductors, one within the other. The inner conductor may or may not be tubular, the matter of primary importance concerning it, being that the sections of the inner conductor should be joined together, end to end, with the outer surfaces in substantially perfect alignment with the points smooth and free of ridges. Similarly, the outer tubular conductor-sections should be joined together, end to end, in substantially-perfect alignment with the joints smooth and free of ridges. This is important, since if the outer surface of the inner conductor or the inner surface of the outer conductor does not form a continuous, smooth, uninterrupted source of travel for the electric current, the radio waves are liable to be distorted. At times, due to defects or breakdowns in certain sections, it is desirable to gain access to remove one or more sections, without having to disturb the other sections. This has heretofore proven to be difficult, if not impossible, to accomplish in a satisfactory manner.

One object of this invention, therefore, is to provide an improved plural electric-conductor joint construction whereby one or more of one or both of the internal and external sections may be removed for repair and replacement by other sections, without disturbing the other sections.

Another object of this invention is to provide an improved plural electric-conductor joint construction in which the sections can be readily removed without disturbing the adjacent sections, with improved gas-tight connections for the sections of the outer conductor, so that a suitable gas-pressure may be maintained within the outer conductor.

Another object of this invention is to provide an improved plural electric-conductor formed of simple elements readily manufactured and readily assembled to produce a durable, efficient construction.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention may best be understood by reference to the accompanying drawings, in which one way of carrying out the invention is shown for illustrative purposes:

Fig. 1 is a front elevation of a plural electric-conductor joint-construction made in accordance with the present invention;

Fig. 2 is a transverse sectional view on line 2—2 of Fig. 1;

Fig. 3 is a central, longitudinal sectional view on line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 3, with the outer gas-tight sleeve-construction disassembled and slid endwise to expose the conductor joint-sections, and with the plural outer conductor joint-sections removed;

Fig. 5 is a view similar to Fig. 4, with the internal conductor joint-section after it has been rotated to bring it to a condition whereby it may be slid transversely for removal in the manner indicated by the broken-line constructions;

Fig. 6 is a transverse sectional view on line 6—6 of Fig. 3;

Fig. 7 is a transverse sectional view on line 7—7 of Fig. 3;

Fig. 8 is a longitudinal central sectional view of the internal conductor joint-section;

Fig. 9 is a transverse sectional view on line 9—9 of Fig. 8;

Fig. 10 is a central longitudinal sectional view of the body-member of the internal conductor joint-section;

Fig. 11 is a perspective view of the guide of one of the connector-members of the internal conductor joint-section;

Fig. 12 is a perspective view of the stud of the connector-member;

Fig. 13 is a perspective view of a key for connecting the parts shown in Figs. 11 and 12; and

Fig. 14 is an elevational view, partly in section, of one end of one of the internal conductor-sections.

Referring to the drawings, the plural electric conductor 20 includes an internal conductor 21 and an external conductor 22 held in substantially coaxial or concentric spaced relation to one another by means of suitable insulators 23 arranged at suitable intervals.

The internal conductor 21 consists of a plurality of internal spaced-apart conductor-sections 24 with an internal joint-section 25 arranged between the spaced-apart ends of each two internal conductor-sections 24.

While the internal conductor-sections 24 could be made solid, they are preferably made tubular for economy. Each internal conductor-section 24 has an anchor or coupling member 26 securely

mounted in each end in any suitable way as for example by sweating the parts together with solder, a portion of which is indicated at 27. Each anchor-member 26 has an annular clearance-channel 28 and an internal screw-thread 29.

Each internal joint-section 25 has a body-member 30 with two connector-members 31 in opposite ends thereof, normally pressed outward away from each other to the position shown in Fig. 8, by means of a coil-spring 32.

Each of the connector-members 31 is an assembly which includes a stud 33, a guide 34 and a key 35. Each stud 33 has a side key-slot 36 formed in the side of its head 37, and a cylindrical shank-portion 38. The cylindrical shank-portion 38 of one of the studs 33 is arranged to slidably fit within the cylindrical bearing-surface 39 of a flange 40 of the body-member 30 and the cylindrical shank-portion 38 of the other of said studs is adapted to slidably fit within the cylindrical bearing surface 41 of a screw ring 42 adapted to be screwed into the screw-threaded hole 43 of the body-member 30. Each stud 33 also has a spring-receiving socket 44 in its head end to receive an end portion of spring 32, and has an end key-slot 45 and an exteriorly-screw-threaded portion end 46 adapted to engage the internally-screw-threaded opening 47 of the guide 34. The key 35 serves to lock the guide 34 relatively to the stud 33 by engaging in key-slots 48 in the guide 34 and in the end key-slot 45 in the end of the stud 33. The two connector-members 31 are identical with the exception that the screw-threads 46 of one are right-hand while those of the other are left-hand for a purpose to be later set forth.

In assembling the parts of an internal conductor joint-section 25 together (see Figs. 8 to 13), passing of the studs 33 into the body-member 30 is accommodated through the screw-threaded opening 43 and the two studs 33 and spring 32 are assembled within the body-member 30 with the spring 32 seated in sockets 44 of studs 33. The screw-ring 42 is thereupon screw-threaded within the screw-threaded hole 43 to form a removable annular flange 49 having the cylindrical bearing-surface 41 to slidably support the cylindrical shank portion 38 of one of the studs 33. Thereupon a key- or locking-pin 50 is inserted through the holes 51 and 52 in flanges 40 and 49, and through the key-slots 36, to secure the studs 33 non-rotatably but slidably within the body-member 30. Thereupon the two guides 34 are screwed in position on the ends of the studs 33 and secured in position thereon by two keys 35. It will be observed that the spring 32 which is mounted within the sockets 44 of the studs 33 pushes the studs 33 together with the other portions forming the two connector-members 31 apart, to the position shown in Fig. 8.

The exterior surface of the body-member 30 of a conductor joint-section 25 is of the same diameter as the exterior surface of each of the conductor-sections 24. As the important thing is to have the exterior annular edges 53 of joint-section 25 contact and form a perfect, smooth, unridged joint with the exterior annular edges 54 of the conductor-sections 24, the inner annular end-portions of the body-member 30 are beveled as at 55 and the corresponding annular portions of the conductor-sections 24 are beveled as at 56. The inner annular surfaces 57 of the end portions of body-member 30 are of the same diameter as the inner annular surfaces 58 of the conductor-sections 24. Each guide 34 has a rounded or beveled end-surface 59 to facilitate its ready entry into the annular clearance channel 28 of a conductor-section 24. The outer annular surface 60 of each guide 34 is as near to the same diameter as the internal surfaces 57 and 58 of the joint-section and conductor-section as will permit the guides 34 to readily slide along the surfaces 57 and 58 to ensure that the outer annular edges 53 and 54 of the joint-sections and conductor-sections are perfectly aligned without formation of any transverse burr or ridge.

The external conductor 22 is formed by spaced-apart tubular external conductor-sections 61 and external tubular joint-sections 62 between and abutting the ends of the conductor-sections 61. The external joint-section 62 is formed of two semi-tubular halves 63 (Figs. 3 and 7). As only the interior surface of the external tubular conductor 22 is important for electrical conduction, the ends of parts 61 and 62 are chamfered as shown in Fig. 3 to insure that the inner annular end-edges will be permitted to be brought into contact in a similar manner to the end external edges of the parts 24 and 25 of the internal conductor 21 previously described. The halves 63 are held in their properly-assembled position shown in Figs. 3 and 7 by means of a closely-fitting exterior sleeve 64 which has screw-threads 65 on its opposite end portions. Each conductor-section 61 has an annular groove 66 in which are seated a pair of half-rings 67 forming a thrust-ring 68. An annular gasket or washer 69 of rubber or other suitable material is located between the thrust-ring 68 and the end-surface of the coupling-sleeve 64. A coupling-ring or nut 70 has an annular end-flange 71 adapted to abut against the edge of the thrust-ring 68, and has an internally-screw-threaded portion 72 to threadedly engage the screw-threaded end-portion 65 of the coupling-sleeve 64. Each coupling-nut 70 is provided with notches 73 for convenience of engaging a spanner-wrench therewith for tightening or loosening the coupling-nuts 70.

The plural conductor can be assembled or installed in position originally, in any suitable way as will be obvious to those skilled in the art of assembling pipe, pipe-fittings, etc.

When it is desired to repair or remove any section of the conductor, the first thing that will be done will be to disassemble the outer coupling-sleeve 64 and nuts 70 to some such position, for example, as is shown in Fig. 4, the two external semi-tubular joint-halves 63 forming joint-section 62 being readily removable transversely without having to move the external conductor-sections 61 longitudinally or otherwise to accomplish this result. The internal joint-section 25 is now exposed to access, and by rotating this section 25 in the direction of the arrow shown in Fig. 5, the right- and left-hand thread constructions of the parts 46 and 29, cause the two studs 33 of the connector-members 31 to be forced inwardly toward one another against the action of the spring 32 until the ends of the studs 33 and the ends of the guides 34 are completely retired within the body-member 30 of the joint-section 25, whereupon the joint-section 25 can be moved transversely out from between the spaced-apart internal conductor-sections 24 without disturbing or moving the latter longitudinally or otherwise.

The broken-line construction 74 shows the joint-section 25 while it is being moved transversely but before it has cleared the ends of the conductor-sections 24, and after the joint-section is moved further to completely clear the ends

of the internal conductor-sections 24 to a position such as shown by the broken-line construction 75 in Fig. 5, the spring 32 forces the studs 33 and the guides 34 out to their original positions. It will be obvious that by suitable manipulation of another joint-section of the conductor that any one or more sections of the conductor can be removed as desired.

Assuming that the conductor-section 24 shown at the left end of Fig. 5 has been removed, it will now be assumed that after repair thereof, the same or a new section is now to be reinserted in position, which can readily be done, as is obvious. Now, to reassemble the joint-section 25 as shown in full lines in Fig. 5, the first operation is to press the guides 34 oppositely inward to the position shown in the broken-line construction 74 in Fig. 5, whereupon the internal joint-section 25 can be slid to the position shown in Fig. 5 in full-line assembled position with the spring 32 pressing the threaded ends 46 into the entrances of threaded holes 29. The joint-section 25 is now rotated in an opposite direction to the arrow shown in Fig. 5, which results in the oppositely-screw-threaded ends 46 of studs 33 threading into the threaded holes 29 of anchor-members 26 and carrying the guides 34 into the channels 28 to the position shown in Fig. 4. Final tightening of the internal joint-section 25 results in tight end-to-end assembly of the joint-section 25 with the conductor-sections 24 as originally. The screw threaded end portion 46 and threads 29 when rotated relatively to one another produce one form of what may be called a cam or camming action.

In assembling the parts as described thus far, the exterior coupling-sleeve 64 and coupling-nuts 70 will be assumed to be arranged on the external conductor-sections as shown in Fig. 4. The semi-tubular joint-halves 63 forming the external joint-section 62 are now brought into position and the coupling-sleeve 64 will be slid endwise from the position shown in Fig. 4 to that shown in Fig. 3 to hold the parts 61 and 62 in perfect alignment. The half-ring members 67 are now inserted in the annular grooves 66 to constitute the thrust-rings 68, and the coupling-nuts 70 are screw-threadedly engaged with the screw-threaded ends 65 of the coupling-sleeve 64 and both nuts 70 are screwed tight in opposite directions to draw the external conductor-sections 61 oppositely relatively to one another to compress the rubber gasket-rings 69 to form a gas-tight joint between the ends of the coupling-sleeve 64 and the outer surfaces of the external conductor-sections 61. At the final limit of movement of the coupling-nuts 70, the end-edges of the conductor-sections 61 and joint-section 62 will be pressed into perfect electrical contact similar to that described concerning the internal conductor-sections. Gas pressure can then be restored within the external conductor.

The internal and external conductor-sections and the body-members of the conductor joint-sections are preferably made of a high-conductivity metal, such, for example, as copper. The other parts except the insulators and soft rubber gaskets, may be made of any suitable material, such, for example, as brass.

The invention may be carried out in other specific ways than that herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections; an internal plural-part conductor joint-section between said internal conductor-sections; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; and an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external conductor-sections in movable connection therewith for removal of the said external conductor joint-section; and said internal conductor joint-section including a body-member and means associated with the body-member normally engaging at least one of the said internal conductor-sections and axially retirable with respect thereto and relatively to the said body-member to permit removal of the said internal conductor joint-section from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

2. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections; an internal plural-part conductor joint-section between said internal conductor-sections and including a body-member and axially-movable connector-members in opposite ends of the body-member and extending into the adjacent ends of said internal conductor-sections; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external tubular conductor-sections in movable connection therewith for removal of the said external conductor joint-section; and said connector-members being movable axially toward each other, out of the adjacent ends of said internal conductor-sections and into the ends of the body-member of the said internal conductor joint-section to permit said internal conductor joint-section to be removed from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

3. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections; an internal plural-part conductor joint-section between said internal conductor-sections and including a rotatable body-member and connector-members in opposite ends of the body-member and extending into the adjacent ends of said internal conductor-sections, the said connector-members being arranged in the body-member for axial movement by rotation of the latter; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external tubular conductor-sections in movable connection therewith for removal of the said ex-

ternal conductor joint-section; and said connector-members being movable out of the adjacent ends of said internal conductor-sections and into the ends of said internal conductor joint-section by rotating the body-member of the said internal conductor joint-section to permit said internal conductor joint-section to be removed from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

4. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections; an internal plural-part conductor joint-section between said internal conductor-sections and including a body-member and axially-movable internal conductor-engaging means ; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external tubular conductor-sections in movable connection therewith for removal of the said external conductor joint-section; and spring-means arranged to act on the internal conductor-engaging means of the said internal conductor joint-section to hold the said means in its internal conductor engaging relation, and the said means being axially movable against the action of the said spring-means out of its said internal conductor engaging relation to permit said internal conductor joint-section to be removed from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

5. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections; an internal plural-part conductor joint-section between said internal conductor-sections; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external tubular conductor-sections in movable connection therewith for removal of the said external conductor joint-section; the said internal conductor joint-section including a body-member and two connector-members, one mounted in each end of the body-member of the said internal conductor joint-section; and spring-means in said internal conductor joint-section to move said connector-members axially apart to extend partly within said internal conductor joint-section and partly within said internal conductor-sections, said connector-members being movable axially toward each other against the action of said spring-means to be moved entirely out of said internal conductor-sections and entirely within the body-member of the said internal conductor joint-section to permit said internal conductor joint-section to be removed from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

6. A plural electric conductor joint-construction comprising: a pair of longitudinally spaced-apart internal conductor-sections having anchor-members in their adjacent ends; an internal plural-part conductor joint-section between said internal conductor-sections; a pair of longitudinally spaced-apart external tubular conductor-sections surrounding said internal conductor-sections; an external tubular conductor joint-section surrounding the said internal conductor joint-section and mounted between said external tubular conductor-sections in movable connection therewith for removal of the said external conductor joint-section; the said internal conductor joint-section including a body-member and two connector-members, one mounted in each end of said internal conductor joint-section; spring-means in said internal conductor joint-section to move said connector-members axially apart to extend partly within said internal conductor joint-section and partly within said internal conductor-sections; and cam means for interconnecting the connector-members and the internal conductor-sections; said connector-members being actuatable by said cam means against the action of said spring-means to be moved axially toward each other, entirely out of said internal conductor-sections and entirely within said internal conductor joint-section to permit said internal conductor joint-section to be removed from between said internal conductor-sections by transverse movement without requiring longitudinal movement of either of said internal conductor-sections, after displacement of the said removable external conductor joint-section.

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