

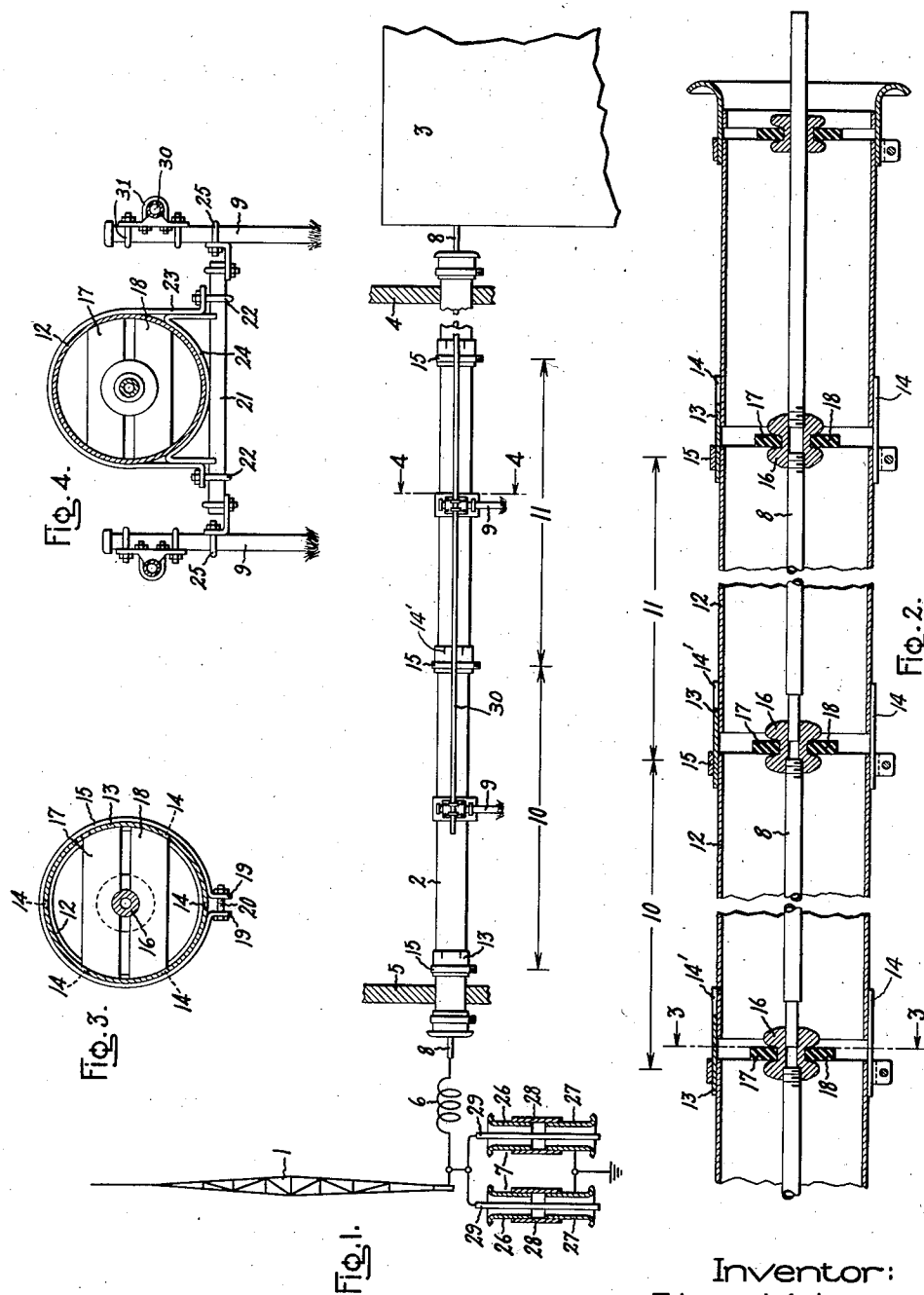
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TRANSMISSION LINE

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TRANSMISSION LINE

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7 Claims. (CL 173—265)

My invention relates to high frequency transmission lines and more particularly to such lines of the concentric type.

One object of my invention is to provide such a transmission line which is of simple and economical construction and which at the same time is so constructed that it may be readily disassembled for repair purposes and the like.

A further object of the invention is to provide a transmission line having the above advantages and which at the same time includes means whereby expansion and contraction of the conductors of the line may occur without injury or displacement of the line.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the accompanying claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the accompanying drawing in which Fig. 1 illustrates an embodiment of my invention; Fig. 2 shows a cross section, in part, of the transmission line illustrated in Fig. 1; and Figs. 3 and 4 illustrate details thereof.

Referring to the drawing, I have indicated at 1 in Fig. 1 an antenna which is supplied with high frequency oscillations through a transmission line 2 from a transmitter 3 which may be located at any desired distance from the antenna. Transmitter 3, for example, may be located in a transmitter building the wall of which is indicated at 4, while the antenna 1 is located in proximity to a second building the wall of which is indicated at 5, the latter of which buildings may house any desired line terminating or tuning equipment which may be employed in connection with the antenna, such for example as the elements 6 and 7 shown in the drawing, and later to be described. The element 6 comprises an inductance which is connected between the antenna and the transmission line for tuning purposes. It will be observed that it is connected to a central conductor 8 which extends throughout the length of the transmission line and into the transmitter 3 where it is of course connected to the output high potential circuits of the transmitter. This conductor is shielded by means of an outer grounded concentric conductor of large diameter which is supported from the earth by means of supports 9.

The transmission line comprising these concentric conductors is made up in a plurality of sections 10 and 11. The mechanical construction

of the line is better illustrated in Fig. 2 which shows a cross section in part of a portion of the line including, for example, sections 10 and 11 of Fig. 1. It will be seen that the outer conductor of each section comprises a large conducting cylinder 12 and that the adjacent ends of adjoining sections of the cylinder 12 are connected by means of a collar 13 which slides over the outer surfaces of the two ends and forms an electrical connection between the two adjacent sections of the conductor. This collar is slitted at 14 to allow it to be easily mounted over the ends of tubes 12 and additional slits, as indicated at 14', are cut from one edge of the collar 13. A band 15 is placed about the edge of the collar opposite the slits 14', whereby the collar may be securely clamped to one of the adjacent ends of the cylinder 12; for example, to the right end of the cylinder of section 10 of the transmission line. The left end of the cylinder 12 of the section 11 of the transmission line by reason of the slits 14' is free to slide within the collar 13.

The sections of the inner conductor 8 are of equal length with the outer conductor and are likewise joined at the ends thereof by means of a sliding connection. This connection comprises a conducting collar 16, arranged within the collar 13, and which is securely attached, as by a screw thread, to the end of one of the conductors 8, as for example to the right end of the conductor 8 of section 10, and slidingly receives the adjacent end of the conductor 8 of section 11. This collar 16 is supported from the collar 13 by means of non-conducting supports 17 and 18 which are better illustrated in Figs. 3 and 4.

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2 and in the direction indicated by the arrow. In this figure the insulating supporting members 17 and 18 for the collar 16 are shown extending as chords across the end of the cylinder 12 and abutting against the inner surface of the outer collar 13, the collar 16 being supported between the two non-conducting supports 17 and 18. In this figure the outer band 15 illustrated in Figs. 1 and 2 is somewhat more clearly illustrated; this band being provided upon one side by projections 19 which are connected together by means of a bolt 20 whereby this band is tightly drawn against the outer periphery of the collar 13 and causing the collar 13 securely to grip the adjacent end of the conductor 12.

The collar 16 is seen to be a massive conductor having somewhat bulbular ends separated by a substantially cylindrical intermediate portion upon which the members 17 and 18 are adapted to fit. The outer surfaces of the bulbular portions of the ring 16 depart from the surfaces of the non-conducting members 17 and 18 gradually, that is, their radius of curvature gradually decreases as the surface departs from the surface of the non-conducting members thereby avoiding sharp corners and distributing the electrical field in such a way as to avoid excessive electrostatic gradients which would produce corona between the non-conducting and conducting surfaces.

The sections of the transmission line may conveniently be about 10 feet in length and since the outer conductor is supported at its middle point practically any sag at the ends of the respective sections is avoided. The connections described whereby adjacent sections are joined allow for expansion of the various sections as well as for quick removal of any section for repair. That is, the distance between the adjacent ends of the conductor 12 of adjacent sections 10 and 11 is sufficiently great to receive the supporting members 17 and 18 and to allow sufficient space to accommodate any expansion which may take place due for example to temperature variation. Similarly, the sliding fit between the collars 16 and the conductors 8 also allows for such expansion.

If it be desired at any time to remove a section of the transmission line, for example, for repairs, it is only necessary to release the bolt 20, slide the collar 13 to the left, remove the non-conducting members 17 and 18, and thence grasp the collar 16, forcing it to the left until it clears the conductor 8 with which it slidably engages. When this has been done the collar 16 and attached conductor 8 may be withdrawn from the section. It is thus seen that the transmission line is very readily assembled and disassembled.

Fig. 4 which is a view from line 4 of Fig. 1, shows one of the supports for the transmission line. This supporting structure comprises the supports 9 on either side of the transmission line provided with the cross bar 21 upon which the transmission line is mounted by means of the metallic band 23 which extends around the cylindrical member 12 and which is drawn downwardly by means of the clamps 22. To avoid any deformation of the cylinder 12 near the point of engagement of the cross bar 21 an additional metallic strip 24 is provided between the cylinder 12 and the support 21, this member being formed to fit the outer periphery of the cylinder 12 and to engage the inner surfaces of the strip 23.

The line may be adjusted laterally by movement of the clamps 22 along the support 21. It may also be adjusted in the vertical plane by raising or lowering the support 21 upon the verticals 9 by means of clamps 25. These adjustments facilitate the alignment of the transmission line during construction.

If desired the top portions of the vertical supports may be interconnected by stringer members 30 which are attached to the vertical supports by clamps 31.

As thus constructed it will be seen that the transmission line may be readily assembled and disassembled and that it, at the same time, is adapted to accommodate any expansion and contraction which may occur due to temperature or

weather variations without any likelihood of buckling or other injury to the line. The inner conductor is sufficiently insulated from the outer conductor to withstand any high voltage which it may be desired to transmit through the line. In one application of my invention the line has been used to transmit substantially 500 kw. of energy at a frequency within the broadcast band over a distance of approximately 800 feet. In this transmission line the sections are about 10 feet in length and the spacing between the adjacent ends of the different conductor sections is such that approximately 14 inches is allowed for expansion of the various conductors, the metal employed being aluminum.

In this application the transmission line was designed to have a surge impedance approximately equal to the radio frequency resistance of the antenna. In the event of any variation of the antenna resistance from that of the surge impedance of the line one or more condensers 7 may be employed between the antenna and ground, thereby to alter the apparent resistance to such an extent as to cause the impedance of the line to match that of the antenna circuit. The condensers 7 are shown as comprising oppositely extending cylinders 26 and 27 which are adjustably joined together by collars 28 thereby to constitute one plate of the condenser the opposite plate of which is a small conductor 29 extending along the axis of the cylinder. The capacitance produced by these condensers may be varied by varying the number of condensers and by adjustment of the spacing between cylinders 26 and 27 by movement of the cylinders either outwardly or inwardly. The outer ends of the cylinders 26 and 27 are flared upwardly to form corona shields.

While I have shown a particular embodiment of my invention it will of course be understood that I do not wish to be limited thereto since different modifications may be made. I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination, in a high frequency transmission line, of a cylindrical conductor comprising a plurality of end to end sections extending throughout the length of said line, a second conductor comprising a plurality of sections of substantially equal length with said sections of said first conductor, means to support said second conductor within said first conductor with the ends of the inner conductor sections in proximity to the ends of the outer conductor sections, said means comprising separate supports extending across adjacent ends of the outer conductor and supporting the two adjacent ends of the inner conductor for free longitudinal movement centrally of the outer conductor, and a collar about adjacent ends of said outer conductor engaged by said supports whereby upon removal of said last collar said separate supports and inner conductor of an adjacent section may be readily removed while other sections of said line are maintained in normal condition.

2. A transmission line comprising a plurality of sections, each section comprising an outer conductive shield and an inner conductor, the ends of said conductive shield and the inner conductor being adjacent, means to support each end of the inner conductor from the end of the outer conductive shield and to permit free longitudinal

movement of one of said ends due to expansion and contraction of said conductor, said means comprising supports extending across an end of said outer conductive shield and supporting the adjacent end of said inner conductor and a collar about the end of said outer conductor and engaged by said supports, and means to support the outer conductive shield at a point intermediate its ends while permitting the ends to move longitudinally due to expansion and contraction.

3. A transmission line comprising a plurality of sections, each section comprising an outer conductive shield and an inner conductor, the ends of said conductive shield and inner conductor being adjacent, a removable band about the external peripheries of each pair of adjacent ends of said outer conductive shields, a plurality of non-conductive members extending transversely of each of said bands and supported thereby between the ends of adjacent sections of said outer shield, said members being so shaped that they are removable upon removal of the associated supporting band, and means including said members for supporting said inner conductors within said outer conductive shields.

4. A transmission line comprising a plurality of sections, each section comprising an outer conductive shield, and an inner high potential conductor, the ends of said outer conductive shield and inner conductor being adjacent, means to insulate said inner conductor from the outer conductor, said means comprising a band about the outer peripheries of adjacent ends of the outer conductive shield, a plurality of non-conductive members extending transversely of said band and supported thereby between adjacent ends of said outer conductive shield, a conductive member supported by said non-conductive members centrally of said outer shield, said conductive member supporting said inner conductor and having conductive surfaces gradually departing from said non-conductive members to form a corona shield.

5. A transmission line comprising a plurality of sections, each section comprising a pair of concentric conductors of substantially equal length, the adjacent ends of adjoining sections

being yieldingly connected by a pair of conducting collars, one of said collars being attached to one end of the outer conductor of one section and arranged slidably to receive the adjacent end of the outer conductor of an adjoining section and the other of said collars being attached to one end of the inner conductor of one section and arranged slidably to receive the adjacent end of the inner conductor of the adjoining section, a plurality of non-conducting supporting strips extending as chords across said outer collar and abutting against the inner surface thereof, said strips supporting between them said inner collar, the spaces between the adjacent ends of the outer conductor being sufficient to receive the ends of said strips and to allow for expansion of said conductors and the space within the inner collar between the ends of the inner conductor being sufficient to allow for expansion of said inner conductors.

6. A transmission line comprising a plurality of sections of concentric conductors, each section being supported at a point intermediate its ends and being unsupported at its ends, both the outer and inner of said concentric conductors being connected by sliding collars to corresponding conductors of adjoining sections, the sliding collar for the inner conductor at each connection being supported from the sliding collar of the outer conductor, by means of non-conducting strips extending as chords across and within said outer collar, said strips supporting between them the collar of the inner conductor.

7. A transmission line including a pair of sections having adjacent ends, each section comprising an outer conductive shield and an inner conductor, the ends of said conductive shield and said conductor being adjacent, and means for supporting the adjacent ends of the inner conductor sections from the adjacent ends of the outer conductive sections, said means including an expansion joint comprising a conductive member mounted on an end of one of said inner conductors and slidably connected to the adjacent end of the other of said inner conductors.

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