April 4, 1939. L. A. BATTERMANN 2,153,527

TRANSMISSION LINE

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Fig. 1

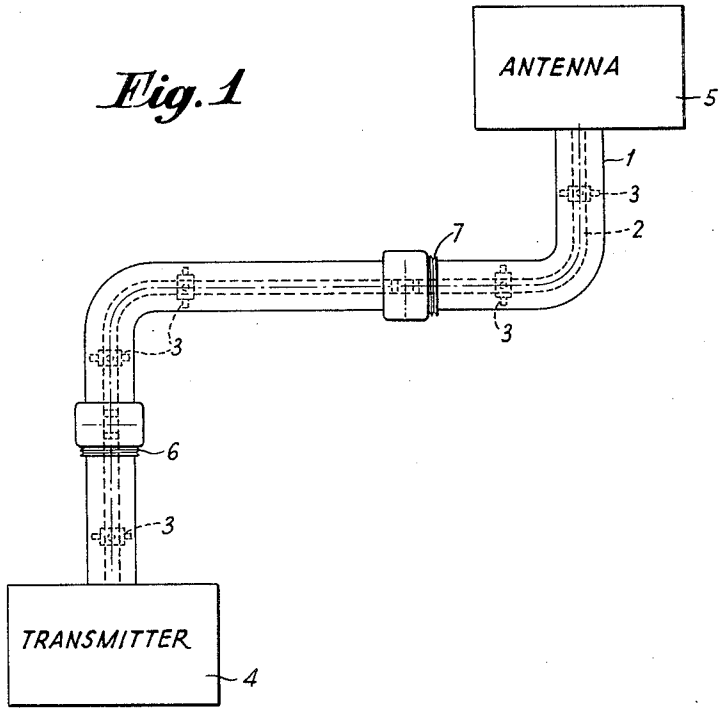


Fig. 2

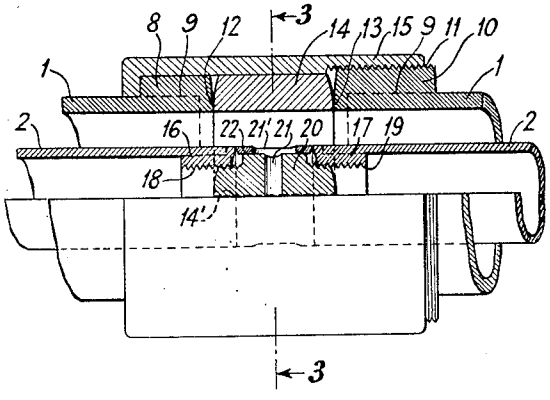
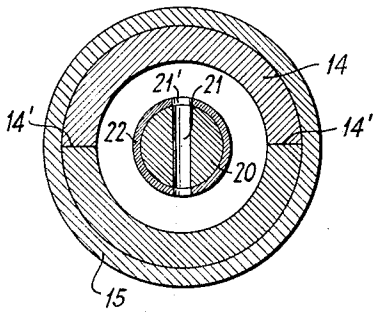


Fig. 3



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TRANSMISSION LINE

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Fig. 4

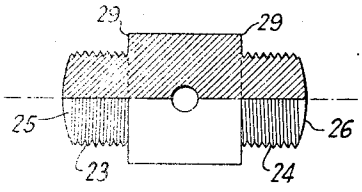


Fig. 5

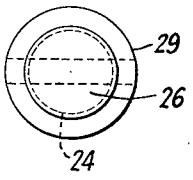


Fig. 6

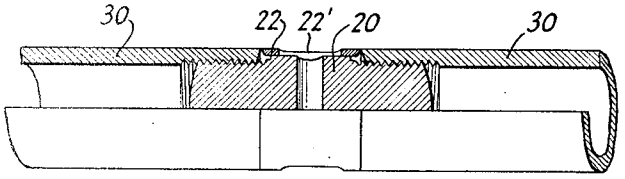
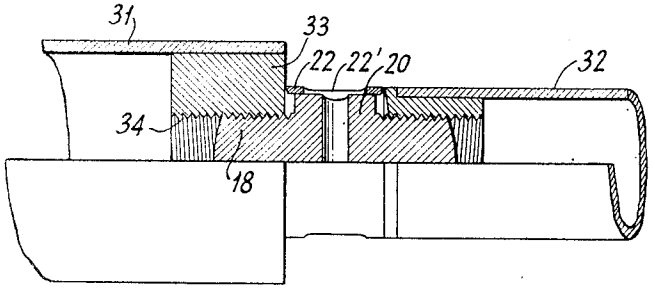


Fig. 7



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UNITED STATES PATENT OFFICE

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TRANSMISSION LINE

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Application July 21, 1936, Serial No. 91,641

10 Claims. (Cl. 174—88)

This invention relates to an improved transmission line of the coaxial type of conductor and is particularly adapted to the method and means of joining the conductor sections together to form a low resistance joint having substantially no high frequency wave reflection even when used with ultra-short wave circuits.

An object of this invention is to simplify and improve the method of joining the several sections of concentric conductors.

Another object of this invention is to provide a transmission line which may be taken apart at will and reconnected again so as to maintain a low resistance joint with substantially no high frequency losses.

Still another object of this invention is to accurately maintain the inside diameter of the outer conductor and the outside diameter of the inner conductor continuously throughout the entire length of the concentric conductor, that is, from the point where the concentric line is connected to the transmitter to the point where the line is connected to the antenna.

A feature of this invention is the improved internal and external unions which allow quick repairs or changes in the transmission lines to be made and at the same time maintain substantially no losses at the ultra-high frequencies.

In the prior art, joints in the outer and inner conductors of a coaxial line were made by soldering, brazing, or by lap or split joints held together by means of screws or bolts. By the first mentioned soldering or brazing method, the conductor could not be conveniently taken apart and frequently there were places in which the inner conductor could not be conveniently reached in order to satisfactorily solder the various sections together. In the second mentioned method, the joints could be taken apart conveniently but they did not present a perfect continuity of low loss electrical path. This present invention makes possible an improved joint which can be immediately disassembled and when reassembled will present a perfectly smooth surface and a perfect continuity of low loss electrical path even when used in an ultra-high frequency circuit.

This invention will best be understood by referring to the accompanying drawings, in which:

Fig. 1 is the general arrangement of the transmission line;

Fig. 2 is a view of the improved coupling of a transmission line shown partly in section and partly in elevation;

Fig. 3 is an end view of Fig. 2;

Fig. 4 is a detail of the improved union for joining the inner conductor, shown partly in section and partly in elevation;

Fig. 5 is an end view of Fig. 4;

Fig. 6 is a detail partly in section and partly in elevation of the inner conductor of a transmission line having substantially heavy metallic walls; while

Fig. 7 is a detail partly in elevation and partly in section of an inner conductor in which the device of this invention is used to join two conductors of unequal diameter.

Referring now in detail to Fig. 1, the coaxial line comprises an outer conductor 1 and an inner conductor 2 which are concentrically spaced apart from each other by any suitable insulation means, such as a star-like or spider arrangement 3. One end of the conductors is joined to a transmitter 4 and the other end is connected to an antenna 5. Certain sections of the inner and outer conductors are joined together at points 6 and 7, the joints of which are to be described in further detail by Figs. 2 and 3.

In Figs. 2 and 3, a section of the outer conductor 1 is provided with a shouldered end 8 which may form a part of the same material as conductor 1 or may be a separate collar as indicated by dotted lines and joined by any suitable means, such as soldering, brazing or welding at a point 9. The other section of the outer conductor 1 is likewise provided with a collar 10 which is threaded preferably with a right-hand thread 11. The end faces of members 8 and 10 are cut on a slight angle so that the maximum length of the conductor occurs at points 12 and 13 each of which is the periphery determined by the inner diameter of the outer conductor, forming a shoulder bearing against the inner end of the outer conductor. A split spacing member 14 radially split at 14' is interposed between the end faces of members 8 and 10, and this member likewise has its end faces chamfered off at a slight angle so as to provide a maximum length at the periphery determined by the inner diameter of the outer conductor. Members 8, 14 and 10 are joined together by means of an external cap-like coupling member 15. As indicated by dotted lines, the inner conductor 2 is provided with internal bushing members 16 and 17 which are fastened integral to the ends of tubes 2 by any suitable means such as soldering, welding or brazing, or threading. Bushing member 16 is preferably threaded with an internal left-hand thread 18 and bushing member 17 is threaded with a right-hand thread 19. An internal plug or stub 20 joins together members 16 and 17. Member 20 is pro-

vided with an aperture 21 in which a suitable rod-like wrench is placed in order that the sections may be securely joined together. A collar or spacing member 22 maintains members 16 and 17 in proper spaced relationship and is provided with slotted apertures 21'. The ends of member 22 are slightly chamfered so that the maximum length occurs at the periphery of the outer diameter. Likewise, members 16 and 17 are correspondingly chamfered so that the points of contact of members 16, 17 and 22 occur only at the point of the outside diameter of the inner conductor 2. It is to be noted that a feature of this construction is that the thrust exerted by the nut member 15 upon collars 8 and 10 is taken by the shoulders on the collars 8 and 10. This important feature also prevents the tightening of the nut 15 from stripping the collars 8 and 10 from the ends of the outer conductor.

Figs. 4 and 5 show a detail of a single internal coupling member which is provided with ends having a left-hand thread 23 and a right-hand thread 24. The ends of the threaded portions 23 and 24 are rounded over at points 25 and 26. As mentioned, the point of contact of the outer periphery is arranged so that its maximum length or point of contact is at the outer edge at point 29 to make contact with the maximum outside of inner conductor 30, should it be desired to omit member 22.

In the modification shown by Fig. 6, the inner conductors 30 are threaded to receive member 20, member 22 having its edge chamfered as mentioned above and the outer diameters of tubes 30 being likewise chamfered so that the point of contact is at the outer periphery where members 30 and 22 join.

Fig. 7 shows a larger pipe or inner conductor 31 joined to a smaller pipe 32, members 20 and 22 being identical with that shown in Figs. 2 and 3, except that the extreme end of pipe 31 is provided with an end plug 33 having a left-hand thread 34 which is of the same diameter as the thread 18.

It is, of course, understood that in the case of a joint around the coaxial conductors of one size and a joint around coaxial conductors of a different size, as shown in Fig. 7, for the inner conductor, there will be correspondingly unequal sizes in the outer conductors which will require a suitable modification of the union 15 for the outer conductor. The joints of the transmission line may be as numerous as required to facilitate the fabrication and installation of the radio equipment. Whenever it is desirable to join a concentric or coaxial transmission line to the stub coaxial line, which is that portion of the transmission lines lying within the confines of the transmitter itself and to which the external part of the transmission line is to be attached or connected, assuming that the transmission line and the stub line are of equal diameter, that is, inner conductor to inner conductor and outer conductor to outer conductor, then the general assembly is as shown diagrammatically in Figs. 2 and 3.

It is, of course, assumed that the transmitter has previously been set in its position and that the transmission line has been built and that there is a space between the ends of the inner conductor equal to the length of the collar 22 and between the outside conductor ends there is a space equal to the length of the split sleeve 14. It is also to be assumed that bushings 16 and 17 have been secured in place and that the union 15 and its restraining collar 8 have been secured to one end say, for example, the stub section of the outside conductor, and the threaded collar 10 has been secured to the transmission line end of the coupling. Then, placing the collar 22 on stud 20, the transmission line 2 is moved away from the stub line so that stud 20 may be started to thread into the bushings 16 and 17, turning member 20 clockwise looking from its front end toward the rear, by means of a rod-like tool through the central aperture 21. Since the collar 22 is longer than the middle section of member 20, it will compensate if both threaded ends of member 20 do not start to thread at the same turn. After members 2 are securely bound together, the tightening rod should be removed and there will be provided a smooth continuous outer surface at the joint of the inner conductor which does not offer high resistance or reflection even to a high frequency electrical current. To fasten the outer conductors together, split sleeve 14 is held in position, the union nut 15 is slid over the outer conductor 1 and threaded onto the threaded sleeve 10, and is tightened by turning nut 15 with a strap wrench. It will be noted by referring to Fig. 2 of the drawings that there is provided a smooth inner surface at the inside joint of the outer conductor which will not offer high resistance of reflection. It will be seen that by joining the sections of coaxial transmission lines together by this invention that it can be accomplished without the application of any heat at the place of installation so that any painted surface is not destroyed, nor is any polished metal discolored.

While only a few modifications of this invention are shown, it is to be distinctly understood that it is not to be limited to these modifications, except those as are shown in the appended claims.

What is claimed is:

1. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating members spacing said conductors in concentric relationship, a chamfered end on each section of said outer and inner conductors, threaded means for joining two sections of both the inner and outer conductors together, securing means interposed between each conductor comprising an external threaded cap having threads at only one end thereof, and an internal threaded member having both ends threaded to join the two sections of the inner conductor together.

2. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating members spacing said conductors in concentric relationship, a chamfered end on each section of said outer and inner conductors, threaded means for joining two sections of both the inner and outer conductors together, clamping means interposed between each conductor comprising an external threaded cap having threads at only one end thereof and an internal threaded member having a right hand thread at one end of said member and a left hand thread at the other end of said member for joining the two sections of the inner conductor together.

3. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating means for spacing said conductors in concentric relationship, a spacing member having the same inside diameter as the inside diameter of

said outer conductor, and an external clamping cap surrounding said spacing member, said member and said clamping cap being interposed between sections of the outer conductor, an internal threaded member having a smaller diameter than the outside diameter of said inner conductor for joining two sections of said inner conductor together, and an internal spacing member interposed between the two sections of the inner conductor, said spacing member having an outside diameter equal to the outside diameter of said inner conductor.

4. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating means for spacing said conductors in concentric relationship, a spacing member having the same inside diameter as the inside diameter of said outer conductor, and an external clamping cap surrounding said spacing member, said member and said clamping cap being interposed between sections of the outer conductor, an internal threaded member having a smaller diameter than the outside diameter of said inner conductor for joining two sections of said inner conductor together, and an internal spacing member having an inside diameter of such a dimension as to be a sliding fit over the central portion of said internal threaded member.

5. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating members spacing said conductors in concentric relationship, a chamfered end on each section of said outer and inner conductors, threaded means for joining two sections of both the inner and outer conductors together including clamping means interposed between each conductor comprising a shouldered member located at each of the ends of said inner and outer conductors, an external threaded cap having threads at only one end thereof for joining two sections of said outer conductor together, and an internal threaded member having a right hand thread at one end and a left hand thread at the other end for joining the two sections of the inner conductor together.

6. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, means for spacing said conductors in concentric relationship, clamping means interposed between each adjacent section of said conductors comprising a shouldered portion located at ends of each adjacent section of said inner and outer conductors, the points of electrical contact being located and maintained at the inside of the outer conductor and the outside of the inner conductor by having chamfered ends on said sections of both the outer and inner conductors.

7. A transmission line having mechanical and electrical coupling elements comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, a chamfered end on each section of said inner and outer conductors, means for insulatingly spacing said conductors in concentric relationship, clamping means interposed between the ends of said conductors comprising a shouldered bushing having its shouldered portion extending above each of the ends of said outer conductor, a second shouldered bushing having its shouldered portion abutting the ends of each section of said inner conductor, a threaded external member clamping said shouldered bushing for joining two sections of said outer conductor together, and an internal member clamping said shouldered bushings for joining two sections of said inner conductor together.

8. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, means for spacing said conductors in concentric relationship, a chamfered end on each section of said outer and inner conductors to maintain the point of electrical contact at the inside diameter of the outer conductor and the outside diameter of the inner conductor, means for joining two sections of both the inner and outer conductors together, said means comprising an external member interposed between the two sections of the outer conductor and having a larger diameter than the outside of the outer conductor, and an internal member interposed between the two sections of the inner conductor and having a smaller diameter than the outside of the inner conductor.

9. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, means for spacing said conductors in concentric relationship, a chamfered end on each section of said outer and inner conductors to maintain the point of electrical contact at the inside diameter of the outer conductor and the outside diameter of the inner conductor, means for joining two sections of both the inner and outer conductors together, said means comprising an external threaded member interposed between the two sections of the outer conductor and having a larger diameter than the outside of said outer conductor, and an internal threaded member interposed between the two sections of the internal conductor and having a smaller diameter than the outside diameter of the inner conductor.

10. A transmission line comprising an outer conductor including a plurality of sections, an inner conductor including a plurality of sections, insulating means for spacing said conductors in concentric relationship, a radially split spacing member having the same inside diameter as the inside diameter of said outer conductor, and an external clamping cap surrounding said radially split spacing member, said radially split spacing member and said clamping cap being interposed between sections of the outer conductor, an internal threaded member having a smaller diameter than the outside diameter of said inner conductor for joining two sections of said inner conductor together, and an external spacing member having an inside diameter of such a dimension as to be a sliding fit over the central portion of said internal threaded member.

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