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2,753,531

ROTARY TRANSMISSION LINE CONNECTION

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2 Sheets-Sheet 1

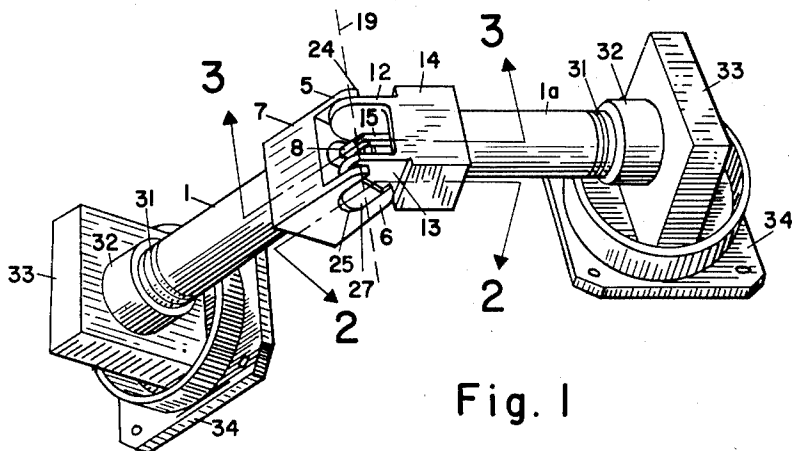


Fig. 1

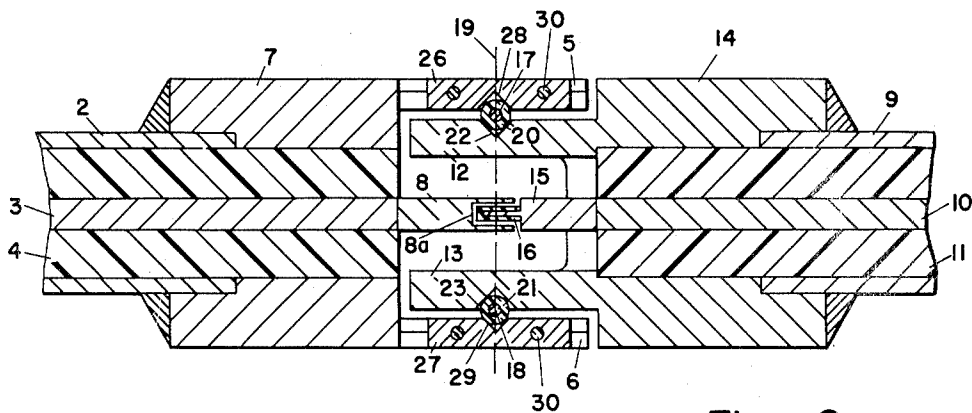


Fig. 2

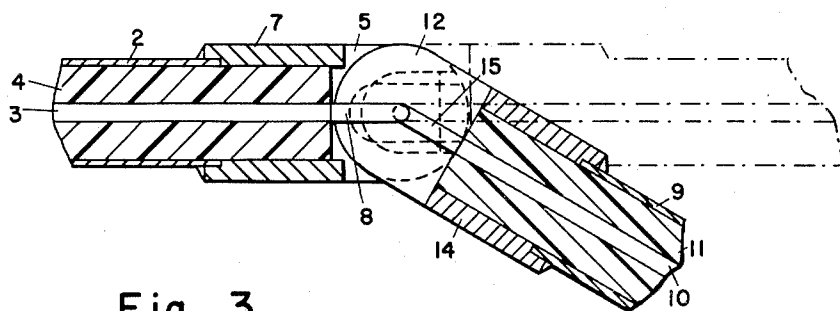


Fig. 3

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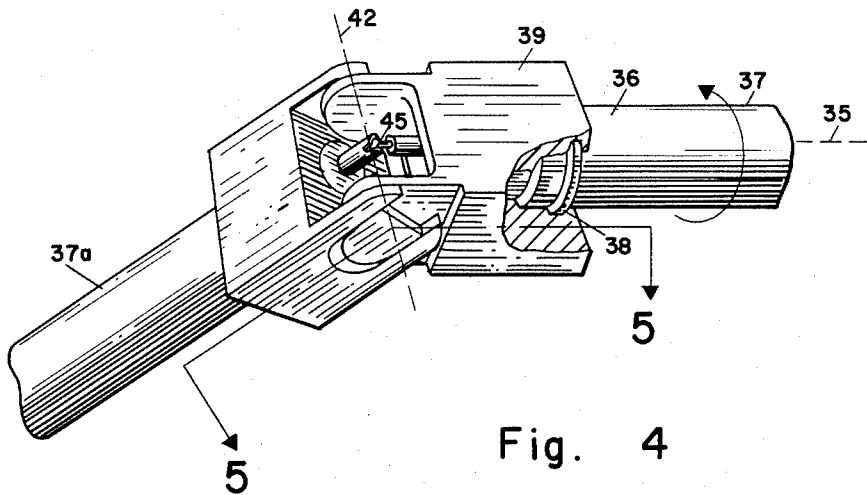
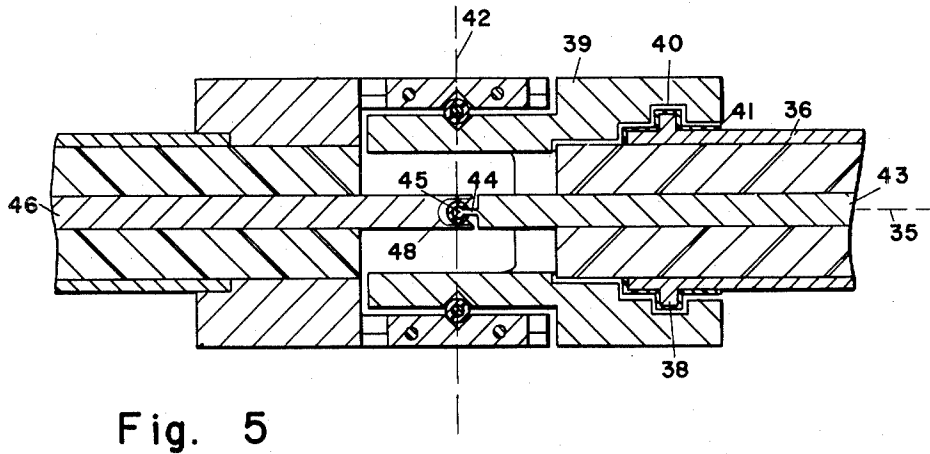
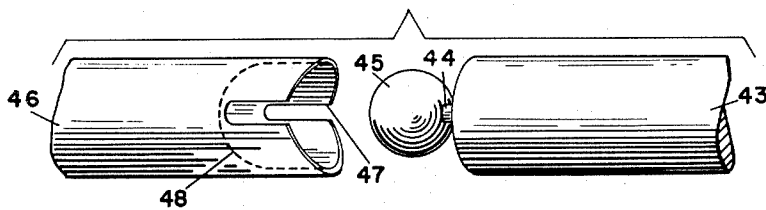
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ROTARY TRANSMISSION LINE CONNECTION

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3 Claims. (Cl. 333—97)

The present invention relates to microwave transmission lines. More particularly, the invention relates to rotary connections for coaxial transmission lines. In the prior art rotary transmission line connections as used for coaxial lines involve a relatively complex and excessively large structure.

It is therefore an object of the present invention to provide an improved rotary transmission line connection which is characterized by a compact and simple structure.

A further object of the invention is to provide an improved rotary transmission line connection which is efficient and reliable in operation.

Other and further objects of the invention will be apparent from the following description of preferred embodiments thereof, taken in connection with the accompanying drawings.

In accordance with the present invention there is provided a rotary transmission line which comprises a first transmission line having a cylindrical outer conductor and an elongated inner conductor coaxial therewith. A first pair of flat, elongated, parallel conductors extends from the outer conductor at diametrically opposed positions and provides parallel ground planes. A conductor extends axially from the inner conductor and has a slot formed in its outer end with a pair of surfaces parallel to the flat conductors. A second transmission line is provided having a second cylindrical outer conductor and a second elongated inner conductor coaxial with a second outer conductor. A second pair of flat, parallel, elongated conductors extends from the second outer conductor at diametrically opposed positions and are disposed between and parallel to the first pair of flat conductors. A conductor extends axially from the second conductor and is disposed in the slot. A pair of axis defining means are so disposed between the first and second pairs of flat conductors as to permit relative rotation between the first and second transmission lines in a plane perpendicular to the axis.

In a preferred embodiment dielectric insulating material, characterized by a low coefficient of friction, maintains the conductors extending from the first and second inner conductors in insulated spaced relation. The inner conductors are then capacitively coupled together to eliminate noise generated by contact.

In a further embodiment of the invention the axis defining means are encapsulated with the dielectric insulating material to maintain the first and second pairs of flat, elongated, parallel conductors in insulated spaced relation thereby providing capacitive coupling therebetween.

In a still further embodiment of the invention jeweled bearings are provided to support the first pair of flat, elongated, parallel conductors in insulated spaced relation to the second pair while permitting relative rotary motion therebetween.

In accordance with a modification of the preferred embodiment, there is provided a rotary transmission line connection comprising a first coaxial transmission line having a cylindrical outer conductor and an elongated inner con-

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ductor coaxial therewith. An annular flange is affixed to the outer surface of the outer conductor adjacent an end thereof. A rotatable cylindrical conductor provides an extension for the outer conductor. The rotatable conductor has an annular slot formed therein adjacent an end thereof and surrounds an end of the outer conductor with the flange disposed in the slot. A first pair of flat, elongated, parallel conductors extend from the rotatable conductor at diametrically opposed positions and provide parallel ground planes. A conductor axially extends from the end and is terminated with a spherical portion at its outer end. A second coaxial transmission line having a cylindrical outer conductor and a second elongated inner conductor coaxial with the second outer conductor is provided. A second pair of flat, parallel, elongated conductors extend from the second outer conductor at diametrically opposed positions and disposed between and parallel to the first pair of flat conductors. A conductor extends axially from the second inner conductor and has a spherical void formed in its outer end and a transverse slot parallel to the flat conductors. The spherical portion of the first axially extending conductor is disposed in the void to permit continuous rotary motion about an axis of the transmission lines. A pair of axis defining bearing means is so disposed between the first and second pairs of flat conductors as to permit limited relative rotation between the first and second transmission lines in a plane perpendicular to the axis.

In the accompanying drawings:

Fig. 1 is a three-dimensional, perspective view of a preferred embodiment of the invention;

Fig. 2 is a sectional view taken along the lines 2—2 in Fig. 1;

Fig. 3 is a sectional view taken along the lines 3—3 in Fig. 1;

Fig. 4 is a three-dimensional view, partly in section, of a modification of the embodiment in Fig. 1;

Fig. 5 is a sectional view of the embodiment in Fig. 4 taken along the lines 5—5 in Fig. 4; and

Fig. 6 is an enlarged, detail drawing of a portion of the embodiment in Fig. 5.

Referring now to the drawings, and with particular reference to Figs. 1, 2 and 3, there is provided a rotary transmission line connection comprising a first coaxial transmission line 1 having a cylindrical outer conductor 2 and an elongated inner conductor 3 coaxial therewith. The conductors 2 and 3 are held in insulated spaced relation by a dielectric insulator 4, such as polyethylene. A pair of flat, elongated, parallel conductors 5 and 6 extend from the outer conductor 2 at diametrically opposed positions and provide parallel ground planes. The conductors 5 and 6 are affixed to the outer conductor 2 through a rectangular tube 7 integrally formed therewith. A conductor 8 extends axially from the inner conductor 3 and has a slot 8a formed in its outer end with a pair of surfaces parallel to the flat conductors 5 and 6, as shown. A second coaxial transmission line 1a has a second cylindrical outer conductor 9 and a second elongated inner conductor 10 coaxial therewith as shown. The conductors 9 and 10 are held in insulated spaced relation by a dielectric insulator 11. A second pair of flat, parallel, elongated conductors 12 and 13 extend from the second outer conductor 9 at diametrically opposed positions and are disposed between and parallel to the first pair of flat conductors 5 and 6 as shown. The conductors 12 and 13 are affixed to the outer conductor 9 through a rectangular tube portion 14. A conductor 15 axially extends from the inner conductor 10 and is disposed in the slot 8a as shown. An end of the conductor 15 is coated with a dielectric insulating material 16 which is characterized by a

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low coefficient of friction, such as "Teflon," trade name for poly-tetra-fluoro-ethylene as manufactured by E. I. du Pont de Nemours and Company. The insulating material 16 maintains the first and second axially extending conductors 8 and 15, respectively, in insulated spaced relation while providing capacitive coupling therebetween to eliminate noise generated by direct metal-to-metal contact.

A pair of axis defining means, ball bearings 17 and 18, are disposed between the two pairs of flat conductors 5, 6 and 12, 13 and permit relative rotation between the two transmission lines 1 and 1a about an axis 19 in a plane perpendicular to the axis as shown. The bearings 17 and 18 are coated with dielectric insulating coatings 20 and 21 having a low coefficient of friction, such as "Teflon." The bearings are supported in V-slots 22 and 23 in the flat conductors 12 and 13, respectively. Slots 24 and 25 are formed in the flat members 5 and 6 to permit the insertion of bearing support members 26 and 27. The members 26 and 27 have conical slots 28 and 29 formed therein respectively as shown. The members 24 and 25 are pinned in place with pins 30. The rectangular tubes 7 and 14 are soldered to the outer conductors 2 and 9 of the coaxial transmission lines. The coaxial transmission lines as shown in the preferred embodiment in Fig. 1 have threaded ends 31 to permit a connection to threaded flanges 32 which connect to rectangular wave guides 33. The guides 33 are affixed to mounting flanges 34 to permit connection into a wave guide transmission line system.

The bearings 17 and 18 may be plastic or jeweled bearings in place of the "Teflon" coated metallic bearing used in the preferred embodiment.

In Figs. 4, 5 and 6, a modification of the embodiment in Fig. 1 is illustrated in which rotation about an axis 35 may take place. Here the outer conductor 36 of a first transmission line 37 has an annular conductive flange 38 affixed to its outer surface adjacent an end thereof as shown. The rectangular tube member 39 has an annular slot 40 formed therein. The outer conductor 36 has an end covered with a dielectric material 41 characterized by a low coefficient of friction such as "Teflon." Rotation about an axis 42 is still possible since the inner conductor 43 of the coaxial transmission line 37 has a cylindrical extension 44 which is terminated with a spherical portion 45. The other transmission line 37a has its inner conductor 46 terminated in a transverse slot 47 to permit limited rotary motion about the axis 42. A substantially spherical void 48 is formed in the end of the inner conductor 46 as shown to permit continuous rotation of the inner conductor 43 relative to the inner conductor 46 about the axis 35.

It will be seen from the above description that the present invention presents a rotary joint for transmission lines of simple and compact construction and with a reliability and efficiency of operation unavailable in the prior art.

While there has been hereinbefore described what are at present considered preferred embodiments of the invention, it will be apparent that many and various changes and modifications may be made with respect to the embodiments illustrated without departing from the spirit of the invention. It will be understood, therefore, that all those changes and modifications as fall fairly within the scope of the present invention, as defined in the appended claims, are to be considered as a part of the present invention.

What is claimed is:

1. A rotary transmission line connection comprising a first transmission line having a cylindrical outer conductor and an elongated inner conductor coaxial therewith; a first pair of flat, elongated, parallel conductors extending from said outer conductor at diametrically opposed positions and providing parallel ground planes; a conductor axially extending from said inner conductor and having a slot

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formed in its outer end with a pair of surfaces parallel to said flat conductors; a second transmission line having a second cylindrical outer conductor and a second elongated inner conductor coaxial with said second outer conductor; a second pair of flat, parallel, elongated conductors extending from said second outer conductor at diametrically opposed positions and disposed between and parallel to said first pair of flat conductors to extend said parallel ground planes; a conductor axially extending from said second inner conductor and disposed in said slot; and a pair of axis defining bearing means so disposed between said first and second pairs of flat conductors as to permit relative rotation between said first and second transmission lines about said axis in a plane perpendicular thereto.

2. A rotary transmission line connection comprising a first coaxial line having a cylindrical outer conductor and an elongated inner conductor coaxial therewith; a first pair of flat, elongated, parallel conductors extending from said outer conductor at diametrically opposed positions and providing parallel ground planes; a conductor axially extending from said inner conductor and having a slot formed in its outer end with a pair of surfaces parallel to said flat conductors; a second transmission line having a second cylindrical outer conductor and a second elongated inner conductor coaxial with said outer conductor; a second pair of flat, parallel, elongated conductors extending from said second outer conductor at diametrically opposed positions and disposed between and parallel to said pair of flat conductors; a conductor axially extending from said second inner conductor and disposed in said slot; dielectric insulating material, characterized by a low coefficient of friction, surrounding an end of the second said axially extending conductor for maintaining the first and second said axially extending conductors in insulated spaced relation, providing capacitive coupling therebetween while eliminating noise generated by direct contact; and a pair of axis defining insulated bearing means so disposed between said first and second pairs of flat conductors as to permit relative rotation between said first and second transmission lines in a plane perpendicular to said axis.

3. A rotary transmission line connection comprising a first coaxial transmission line having a cylindrical outer conductor and an elongated inner conductor coaxial therewith; an annular flange affixed to the outer surface of said outer conductor adjacent an end thereof; a rotatable cylindrical conductor providing an extension for said outer conductor and having an annular slot formed therein adjacent an end thereof, said rotatable conductor surrounding an end of said outer conductor with said flange disposed in said slot; a first pair of flat, elongated, parallel conductors extending from said rotatable conductor at diametrically opposed positions and providing parallel ground planes; a conductor axially extending from said inner conductor and having a spherical portion at its outer end; a second coaxial transmission line having a second cylindrical outer conductor and a second elongated inner conductor coaxial with said second outer conductor; a second pair of flat, parallel, elongated conductors extending from said second outer conductor at diametrically opposed positions and disposed between and parallel to said first pair of flat conductors; a conductor axially extending from said second inner conductor and having a spherical void formed in its outer end with a transverse slot having a pair of surfaces parallel to said flat conductors, said spherical portion of the first said axially extending conductor being disposed in said void and permitting restricted rotary motion through said slot; and a pair of axis defining bearing means so disposed between said first and said second pairs of flat conductors as to permit limited relative rotation between said first and second transmission lines in a plane perpendicular to said axis.

No references cited.