

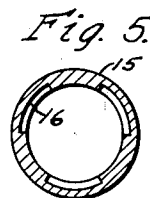
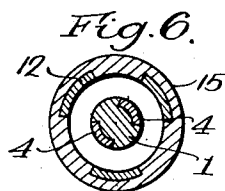
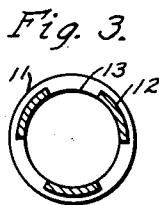
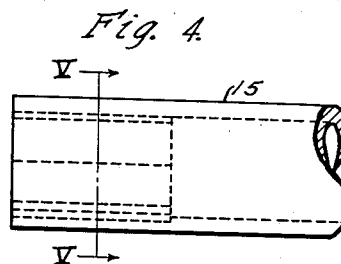
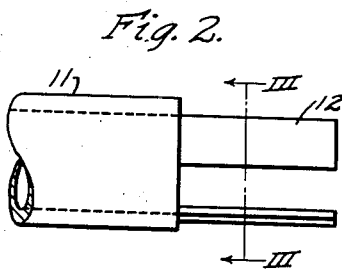
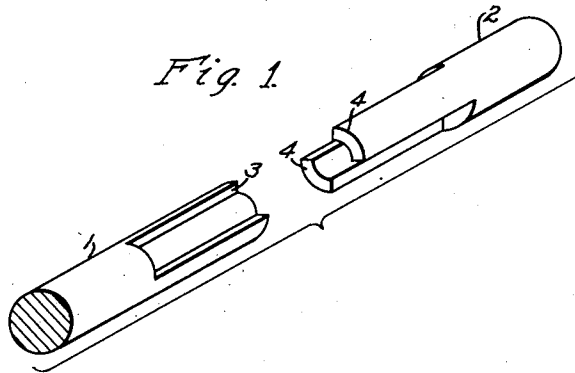
May 17, 1949.

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2,470,631

SLIDING JOINT FOR TRANSMISSION LINES

Filed July 28, 1943



WITNESSES:

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2,470,631

SLIDING JOINT FOR TRANSMISSION LINES

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Application July 28, 1943, Serial No. 496,520

3 Claims. (Cl. 174—21)

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My invention relates to transmission lines for ultra-high frequency electric currents and, in particular, relates to a method for providing sliding joints by which the length of segments of such lines may be varied.

One of the most satisfactory types of transmission lines for ultra high frequency electric currents is the so-called concentric type of line in which one line comprises the central core insulated and spaced from a surrounding sheath, both core and sheath being of conducting material. It is frequently desirable that segments of such lines shall be varied in length at will over a substantial range, since any discontinuity in the electrical constants of the line produces reflected waves and results in resonance effects of greater or lesser degree in segments of the line intervening between such discontinuities.

By making the distance between the points of discontinuity variable, various tuning effects can be attained as a result of such resonance, and such tuning proves to be highly desirable in certain instances.

In accordance with the prior art the effective length of segments of concentric lines is made variable by providing sliding joints in the core and outer sheath. In such arrangements one portion of the sheath is reduced sufficiently in diameter to slide into and telescope in electrical contact with the other portion. The central core is similarly provided with a sliding telescopic connection by enlarging one portion and boring it out so that it can slide over the other portion. However, when one portion of the sheath or core slides telescopically within another portion the above-mentioned alteration in the outside and inside diameters of the core and sheath at the joint change the electrical constants such as self-inductance and capacitance per unit length of the line, and these alterations in diameter in themselves constitute a minor discontinuity in the line which would be desirable to minimize.

In accordance with my invention I avoid alteration in the exterior and interior diameters of both the sheath and the core at a sliding joint by a novel form of conductor structure which will be described more fully below.

One object of my invention is accordingly to provide a sliding joint for an electrical conductor which shall maintain constancy of interior and exterior diameters of the conductor on each side of the joint.

Another object of my invention is to provide a sliding joint for transmission lines of the concentric type in which the exterior and interior diameter of the sheath and the core are maintained the same on each side of the joint.

Still another object of my invention is to provide a form of electrical conductor for ultra-high frequency electrical transmission having a sliding joint in which variations in the electrical con-

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stants of the conductor at the joint are minimized.

A still further object of my invention is to provide a concentric transmission line for ultra high frequency current which shall have a sliding joint or joints by which its electrical length may be varied, the joints being of such a type as to minimize the reflection of high frequency energy in crossing them.

Other objects of my invention will become apparent upon reading the following description taken in connection with the figures of drawings in which:

Fig. 1 illustrates the two halves of a slidable joint in a cylindrical conductor which may, for example, be the central core of a concentric transmission line.

Fig. 2 illustrates one member of a slidable joint in a tubular type of conductor which may be the sheath of a high frequency transmission line.

Fig. 3 is a section along the line III—III in Fig. 2.

Fig. 4 is an elevational view of a tubular conductor adapted to cooperate with that shown in Fig. 2 to form a slidable joint and which is suitable for the sheath of a concentric transmission line; and

Fig. 5 is a section along the line V—V in Fig. 4.

Fig. 6 is a section through a transmission line having its core portions interconnected by the joint of Fig. 1 and its sheath portions interconnected by a joint of the type shown in Figs. 2 through 5.

Referring in detail to Figure 1, a cylindrical conductor suitable for a core of a concentric transmission line comprises two members 1 and 2 having the same diameter. The member 1 is provided with a portion near its end in which two diametrically opposite sectors each spanning preferably 90 degrees of circumference are cut away to form longitudinal channels 3. The member 2 has one end bored hollow for a distance preferably having a length equal to that of the recessed channels 3, this bore being of the same diameter as the bottom of the channels 3. The tubular walls formed in the bored-out portion of the member 2 are then cut away to form two projecting fingers 4 which are adapted to slide in and engage the walls and bottom of the channels 3 in the member 1. Thus, when the portions 1 and 2 are brought together so that the fingers 4 slide in and closely engage the walls of the channels 3, the members 1 and 2 may be moved together or apart for a substantial distance, while still maintaining good electrical contact between the engaging surfaces of the sliding joint. The diameters of the members 1 and 2 being the same there is no difference in the diameters of the conductor on opposite sides of this sliding joint.

Referring in detail to Figs. 2 and 3, a tubular conductor 11 which may constitute the sheath

of a concentric transmission line has its wall thickness reduced by one half for a distance back from one end substantially equal to the length of the channels 3 in Fig. 1. In addition the tubular portion of reduced diameter is cut away to form three projecting fingers separated by open spaces, the fingers and spaces each occupying preferably 60° of the circumference of the tube.

Referring to Figs. 4 and 5, a second tube conductor 15 of the same diameter outside and inside as the member 11 in Fig. 2, and which may constitute a portion of the sheath-conductor of a concentric transmission line, has recesses or channels 16, each occupying preferably 60° of its circumference and having a depth preferably equal to one-half the wall thickness of the conductor 15 cut in its interior surface. The axial length of the channels 16 is slightly greater than that of the fingers 12 in Fig. 2. The radial and circumferential dimensions of the fingers 12 in Fig. 2 and the channels 16 in Fig. 4 are preferably made such that the fingers 12 can slide with all contiguous surfaces engaging within the channels 16.

It will be evident that the tube 11 of Fig. 2 and tube 15 of Fig. 4 are adapted to form the respective halves of a sliding joint in a continuous conductor. Since the inside and outside diameter of the members 11 and 15 are the same, it will be evident that there is no variation of such diameter in crossing this sliding joint from one side to the other.

While the exterior and interior diameters of both the cylindrical conductor of Fig. 1 and the tubular conductors of Figs. 2 and 4 suffer no alteration in passing from one side of the sliding joint to the other, there will be a slight variation in impedance in passing from point to point axially along the joint. Nevertheless this variation of impedance will be substantially smaller than was the case where conductors of the prior art employ sliding joints of a type in which one tube or cylinder slides and telescopes within another of somewhat different diameter.

While I have illustrated the principles of my invention in a cylindrical conductor having only two projecting fingers, each one spanning 90° of the circumference of the conductor and have illustrated it by a tubular joint having three fingers spanning 60° circumferentially, it will be evident that the number of fingers and the associated recesses may be increased above these values and made as large as may be desired by decreasing the number of degrees of circumference spanned by each finger. When the number of fingers is thus increased, the impedance becomes more and more nearly uniform throughout the axial length of the joint regardless of the degree of axial displacement of two members of the joint.

While I have illustrated the principles of my invention by describing a specific embodiment, it will be evident to those skilled in the art that the principles thereof are of a broader application in phases which will be evident.

I claim as my invention:

1. A concentric transmission line comprising a core conductor provided with a sliding joint comprising a first member having a plurality of arcuate projecting fingers of conducting material separated circumferentially by gaps, and a second member of conducting material having the same outside diameter, and having a plurality of circumferentially displaced channels

positioned and dimensioned to engage said fingers in sliding contact, the two portions of said linear conductor projecting in opposite directions from said joint, and a sheath conductor comprising two tubular portions of the same inside and outside diameters one said portion having projecting fingers circumferentially separated by gaps and the other having channels adapted to engage the surfaces of said fingers in sliding contact.

2. A concentric transmission line comprising a core conductor provided with a sliding joint comprising a first member having a plurality of arcuate projecting fingers of conducting material separated circumferentially by gaps, and a second member of conducting material having the same outside diameter, and having a plurality of circumferentially displaced channels positioned and dimensioned to engage said fingers in sliding contact, the two portions of said linear conductor projecting in opposite directions from said joint, and a sheath conductor comprising two tubular portions of the same inside and outside diameter, one said portion having projecting fingers circumferentially separated by gaps and the other having channels adapted to engage the surfaces of said fingers in sliding contact, the interior diameter of said fingers being the same as that of said tubular conductors and the exterior diameter of said fingers being less than the exterior diameter of said tubular portion.

3. A concentric transmission line comprising a core conductor provided with a sliding joint comprising a first member having a plurality of arcuate projecting fingers of conducting material separated circumferentially by gaps, and a second member of conducting material having the same outside diameter, and having a plurality of circumferentially displaced channels positioned and dimensioned to engage on three sides said fingers in sliding contact, the two portions of said linear conductor projecting in opposite directions from said joint, and a sheath conductor comprising two tubular portions of the same inside and outside diameters one said portion having projecting fingers circumferentially separated by gaps and the other having channels adapted to engage on three sides the surfaces of said fingers in sliding contact.

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