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LINE STRETCHER

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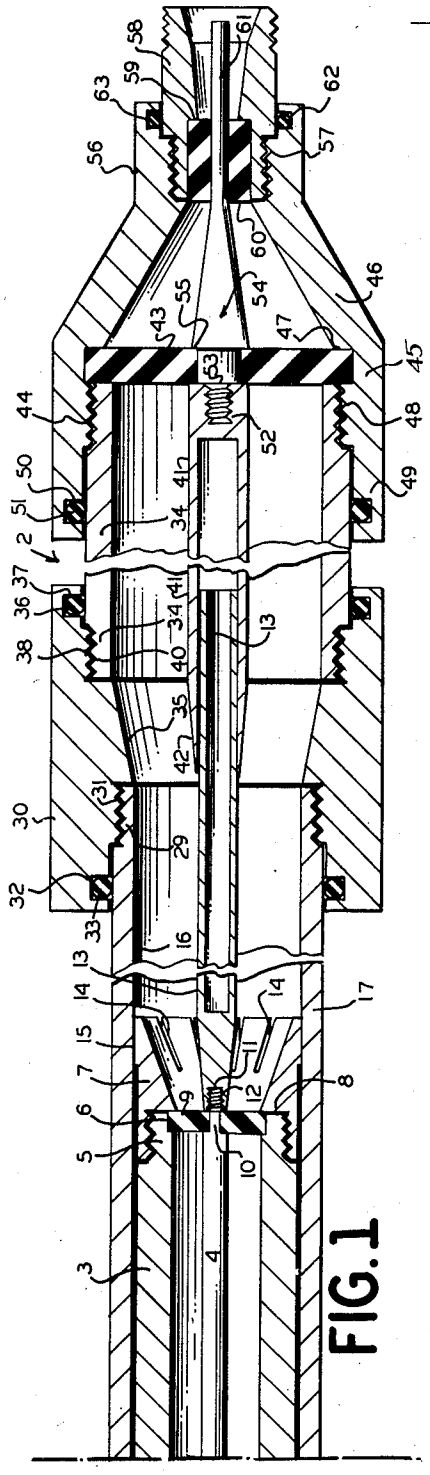


FIG. 1

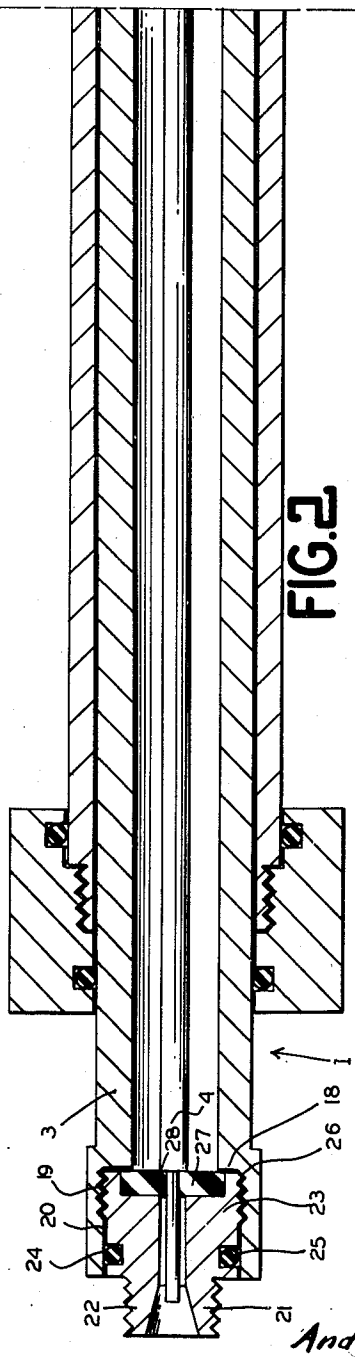


FIG. 2

INVENTOR.
Andrew Alford
BY Ezekiel Wolf
his Attorney.

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LINE STRETCHER

Andrew Alford, Cambridge, Mass.

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1 Claim. (Cl. 333—31)

The present invention relates to a line stretcher useful in the conduction of ultra high frequency electromagnetic waves by means of which coaxial cables and transmission lines may be easily connected together.

The line stretcher of the present invention comprises conductive outer and inner cables or conductors which may be telescoped together or apart without changing the characteristic impedance of the lines formed by the telescoped members of the line stretcher. The outer and inner conductors may form a coaxial cable of the usual type with a cylindrical hollow outer conductor and a coaxial cylindrical inner conductor or the cross sections of the outer and inner conductors may have other shapes such as oval or partly open, and still effectively act as coaxial cables. The term coaxial cable as related to the line stretcher of the present invention is to be understood as including in its scope various sectional shapes of conductors whether open or closed, which act and serve in the same way as cylindrical coaxial cables.

In the present invention the line stretcher is so designed that in whatever position of extension or contraction the stretcher may be, the characteristic impedance of the line at any point is substantially the same. To this end the line which comprises the stretcher maintains substantially a constant ratio of inner diameter of the outer conductor to the outer diameter of the inner conductor.

A further feature of the present invention is that in the regions where the inner or outer conductors have their outer and inner dimensions respectively enlarged or decreased, such changes are made gradually avoiding reflections, at the same time preserving the ratios of dimensions such that the characteristic impedance of the stretcher as a line or coaxial cable will not change.

It is also necessary in a device of the type described to provide good conductive connections between the sliding elements and further to construct the device so that it will withstand severe conditions under which the device may be used. The sliding joints and the end joints which are exposed to the atmosphere are all hermetically sealed so that the unit will remain dry on the inside.

Other features of the present invention will be more fully understood in the specification as set forth below when read in connection with the drawing illustrating an embodiment of the invention in which:

Figure 1 shows a part of the line stretcher; and,

Figure 2 shows a continuation from the broken end of Figure 1.

The line stretcher of the present invention is formed in general as a coaxial cable which may be cylindrical or have any other suitable cross section as long as the elements of the device may be telescoped with reference to each other. The use, therefore, of the term "coaxial cable" is to be taken in its general sense in which an inner conductor is coaxially aligned with an outer conductor whether the outer conductor provides a complete conductive enclosure or not.

The device of the present invention comprises two

telescopic sections designed generally 1 and 2. The section 1 comprises in itself an outer conducting tube, cylinder, or other shaped member 3, and an inner conducting tube or rod 4 which may be coaxial with the conducting tube 3. The inner and outer tubes 4 and 3 respectively are fixed with reference to each other and are moved simultaneously. The tube 3 at its right end as seen in Figure 1 terminates in an external threaded shoulder 5 and in an internal shoulder 6. The externally threaded shoulder has screwed tightly to it a sleeve 7 which has an internal flange 8 extending inwardly at its left end to the same diameter as the inner diameter of the tube 3 thereby effectively providing a grove between the sleeve 7 and the tube 3 for receiving the insulating disc or washer 9 which has an opening in the center in which a shoulder 10 of the inner tube 4 is seated.

The inner tube or rod 4 has a threaded end 11 which screws into the threaded end 12 of the inner conductor 13 belonging to the other section 2 of the line stretcher. It will be seen that this construction clamps the inner conductor 4 tightly in place and spaces this conductor properly with respect to its outer conductor 3. The ratio of the inner diameter of the outer conductor to the outer diameter of the inner conductor is maintained the same from the transition of one set of conductors to the other. In order to make a good connection, the sleeve 7 at its right end, as seen in Figure 1, is radially slotted as indicated at 14, 14, etc., and the end of the sleeve has a slightly outwardly projecting section 15 thereby making the free effective diameter of the end of the sleeve larger than the outer diameter of the conductor 3. This permits this section of the sleeve along the surfaces of the projections 15 when contracted to provide a spring tensioned sliding fit along the inner surface 16 of the tube 17 forming a section of the outer conductor of the element 2.

The left end of the inner conductor 3 is terminated in an inner shoulder 18 which is threaded for a section 19 and then recessed to a slightly larger diameter at 20 to receive the end collar or sleeve 21. This collar 21 is provided with a threaded end 22 which terminates in an enlarged external section 23 having a groove 24 around its outside in which an O ring 25 is positioned for making a tight seal between the connection. The enlarged section 23 has a threaded portion 26 which has a smaller diameter than the rest of the section 23 and is received in the shoulder 18 at the threaded section 19 of the shoulder. The collar section 21 clamps the insulating washer 27 tightly against the inward face of the shoulder 18 and also against the shoulder 28 at the end of the inner conductor 4. In this way the inner conductor 4 and the outer conductor 3 of the section 1 are rigidly held together and spaced by the two insulating washers 9 and 27. The outer conductor 17 of the telescopic section 2 terminates at its right end in a threaded section 29 recessed inwardly slightly. An external sleeve 30 is tapped at 31 to receive the threaded end 29 and this section projects slightly inwardly of the left end of the bore of the section 30 so that the groove 32 with its O ring 33 will not be disturbed or marred as the tube 17 is screwed into place. The connecting section 30 which connects the end of the tube 17 with the end of the tube 34 which has a larger inner diameter than that of the tube 17 has an expanding tapered section 35 positioned between the ends of the tubes 39 and 34 so that a gradual enlargement of the inner diameter of the outer conductor is provided.

At the right end of the section 30 there is provided a groove 36 having an O-ring 37 and a threaded section 38 which is of a smaller diameter than the end where the O ring is situated and threaded to receive the threaded end 40 of the tube 34. The enlargement of the inner diameter of the outer tube is necessary since the outer diameter of the inner tube 41 is enlarged to receive the

end 13 of the inner conductor of the first telescoping section which is the continuation of the conductor 4.

The left end of the tube 41 is provided with a sliding friction fit over the surface of the inner tube 13. In this case the end radially slotted segments 42 have inwardly projecting surfaces which bear against the outside of the tube 13 for a spring friction sliding fit to maintain a good clean electrical contact. The right end of the tube 41 and the right end of the tube 34 are spaced from one another by the insulating washer or ring 43. This is held in place in the manner which will be described below.

The outer end section of the tube 34 is recessed and threaded as indicated at 44 to receive the outer end conducting section 45 which has a conical tapering section 46, the larger end of which is provided with a shoulder 47 and an inwardly threaded cylindrical section 48 which is threaded to fit to the section 44. The end collar or sleeve portion 49 of the element 45 has a larger diameter than the threaded section 48 but fits closely over the outside of the tube 34 and is provided with the usual groove 50 and the O ring 51 to make a tight seal. By seating the end conducting element 45 in place, an insulating washer 43 is firmly clamped against the end face of the tube 41 which is preferably a solid rod as indicated at 52 and tapped to receive a threaded boss or projection 53 of the inner conductor terminal element 54 which provides a right terminal of the inner conductor. This element 54 has an inwardly projecting shoulder 55 which may be clamped tightly against the washer 43 by screwing the projection 53 tightly in place. The outer section 45 is provided with an end circular collar section 56 threaded internally at 57 in an inwardly projecting section of the collar to receive the end terminal element 58. The terminal element 58 is provided with an internal shoulder 59 which holds the insulating washer or ring 60 in place, through which the stem 61 of the member 54 passes thereby supporting and spacing it from the inside of the member 58.

The collar section 56 of the element 45 is provided with a groove 62 near its right end in which an O ring 63 is positioned so that this end is securely sealed.

It will be noted from the description given above that the telescopic section 2 has through its length external and internal conductors which are fixed with respect to one another and move together. The elements 45 and 54 respectively expand proportionately and at their terminal ends merge into conductors 34 and 41 whose ratio of inner diameter and outer diameter respectively remain the same as in the preceeding expanding section.

At the coupling section 30 where the outer conductor 34 merges into the outer conductor 17 while the inner conductor 41 merges into the inner conductor 13 of the first section, the diameters are respectively contracted

to preserve the same ratio. The same ratio is also held through the contracting section where the conductor 3 becomes the outer conductor and the conductor 4 becomes the inner conductor. Not only is this ratio maintained in one position but in all positions for which the device may be telescoped together or apart. There are vary small sections in the line stretcher where the spacers are held in position where this ratio is not strictly maintained but the thickness of these spacers is insignificant with respect to the shortest wave length transmitted and therefore may be neglected. Even in these sections, however, it is possible to preserve the desired ratios where such exactness is required.

A sealing collar is illustrated in Figure 2 is threaded to the outer tubular section 17. A pair of O rings are positioned on either side of the threaded section of the sealing ring with one O ring located between the sealing ring and the tubular section 17 and the other O ring located between the ceiling ring and the outer conductor 3.

Having now described my invention, I claim:

In a line stretcher of the type described having two telescopic coaxial conductive sections slidably fitting into one another, said one section comprising concentric outer and inner conductors, an end conductive plug fitting into one end of said outer conductor having a coaxial bore with an insulating ring at the inner end thereof, a second insulating ring having a coaxial bore secured in a shoulder at the other end of said outer conductor, an end clamping collar threading over the end of said outer conductor clamping said second insulating ring, said collar having a small outwardly projecting shoulder at its end radially sectioned such that the outer surface of the collar may make good conductive contact with the inner conductive surface of the outer conductor of the other section and an inner conductor for said one section having shoulders at its ends with a reduced diameter abutting respectively said insulators with the reduced ends of the inner conductor extending through said insulating rings and clamped firmly in place by said end plug and said collar.

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