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Virgile, L. G., "Deflection of Waveguide Subjected to Internal Pressure," MTT-5, 10/1957, pp. 247-250.

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[54] **DEFLECTION-FREE WAVEGUIDE**
ARRANGEMENT
3 Claims, 3 Drawing Figs.

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 333/98, 138/155, 29/600

[51] Int. Cl. H01p 1/04,
 H01p 3/12, H01p 11/00

[50] Field of Search 333/95, 98;
 29/600, 601; 138/114, 142, 155

[56] **References Cited**

UNITED STATES PATENTS

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ABSTRACT: A waveguide transmission line comprising a series of sections, each section comprising a section of waveguide disposed within a section of a larger diameter rigid jacket and bound, under tension, at both ends of the jacket. This structure is used to substantially eliminate deflections in short sections of the waveguide. Advantageously, the space between the waveguide and the jacket is filled with a flexible material such as rubber or plastic foam to prevent sag due to gravitational force.

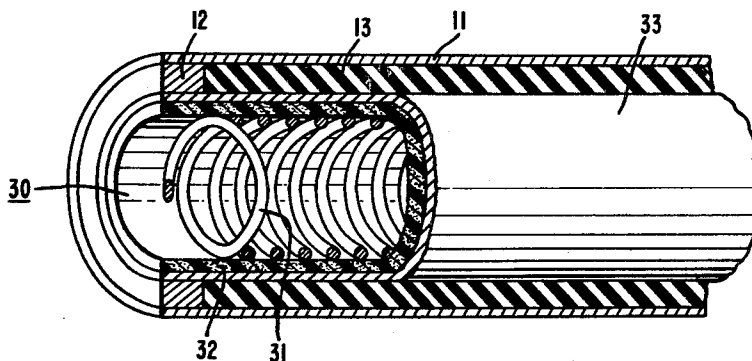


FIG. 1

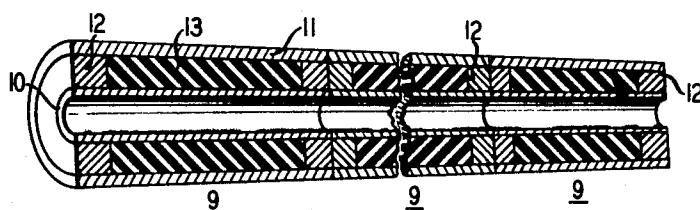


FIG. 2

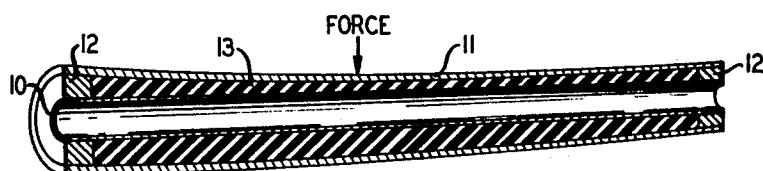
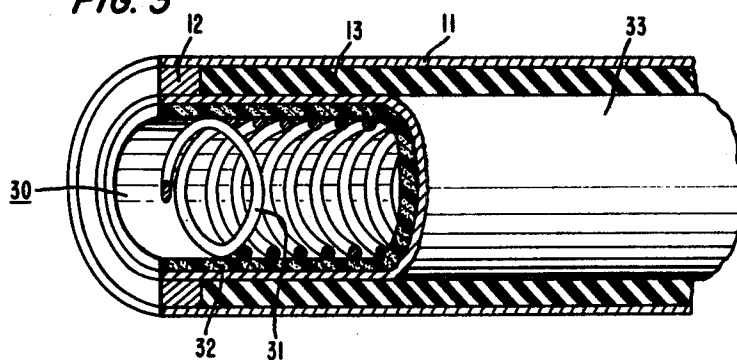


FIG. 3



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DEFLECTION-FREE WAVEGUIDE ARRANGEMENT

This invention relates to a waveguide transmission line which is substantially free of deflections from straightness along short sections.

BACKGROUND OF THE INVENTION

Waveguide transmission lines are now deemed feasible for use as extremely broad frequency band transmission media for long-distance communications systems. (See, for example, S. E. Miller, "Waveguide as a Communication Medium," 33 BSTJ 1209, Nov. 1954). Among numerous other requirements for satisfactory service, such a transmission line must be protected from deflections in short sections caused, for example, by falling rocks in back-filling the trench in which the waveguide is placed. Otherwise unwanted mode conversions will take place at such deflections, resulting in a loss to the system.

SUMMARY OF THE INVENTION

In accordance with the invention, the waveguide is formed as a series of sections, each section being disposed within a larger rigid jacket and bound, under tension, at both ends of the jacket. Advantageously, the space between the waveguide wall and the jacket is filled with a flexible material such as rubber or plastic foam. Thus, along most of its length, the section of waveguide is mechanically isolated from the rigid jacket, and typical deformations of the jacket are not transmitted to the waveguide.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages and features of the invention will become apparent from the following detailed description of the arrangements illustrated in the drawings in which:

FIG. 1 illustrates a cross section of a waveguide transmission line in accordance with the invention;

FIG. 2 illustrates the effect of short period deflections on a section of the waveguide transmission line of FIG. 1; and

FIG. 3 illustrates a section of helical waveguide in accordance with the invention.

DETAILED DESCRIPTION

FIG. 1 illustrates a cross section of a waveguide transmission line in accordance with the invention comprising a plurality of coupled sections 9 of waveguide structure. Each section comprises a section of waveguide 10, such as circular electric mode helical waveguide, mechanically coupled to a rigid outer jacket 11, such as a steel tube by solid supports 12 capable of maintaining waveguide 10 under a tension of a few thousand pounds. For example, supports 12 can comprise annular metal rings securely welded to jacket 11 and having an inside diameter approximately equal to the waveguide and a length of a few inches. The waveguide can then be brazed or welded to the inner surface of the rings while under tension. Alternatively, both the rings and the ends of the waveguide

can be threaded to provide a simple means of applying tension and epoxy resin, for example, can be used to lock the threads in position.

The space between waveguide 10 and rigid jacket 11 is advantageously filled with a flexible material such as foam rubber which provides sufficient resistance to reduce sag in the waveguide from gravity but is sufficiently flexible that the tension on the waveguide will keep it straight despite localized deflections of the rigid jacket. FIG. 2 illustrates, in a somewhat exaggerated manner, the effect of a deflection on a section of waveguide structure. While the rigid jacket bends, the flexible foam transmits only a negligible portion of the distorting force, and the tension on the waveguide keeps it substantially straight.

FIG. 3 shows a section of a typical millimeter, circular electric mode transmission system employing the techniques of the present invention. The section includes a length of helical waveguide 30, of the type described by S. E. Miller in U.S. Pat. No. 2,848,696, comprising an inner helix 31, surround by a lossy dielectric material 32, and an outer protective metallic cylinder 33 having a wall thickness of about one-tenth of an inch. The rigid jacket 11 is 3/16 inches steel pipe having an inside diameter of about 3 inches. The structure can be conveniently fabricated in sections of 15 to 30 feet in length. The tension between the waveguide and the rigid jacket depends upon the strength of the waveguide. For a typical helical waveguide structure of the type described above, the tension is on the order of a few thousand pounds, typically about 5,000 pounds.

Numerous and varied other arrangements and modifications of the above-disclosed specific illustrative embodiment can be readily devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A waveguide transmission line comprising a plurality of coupled sections of waveguide structure, each section comprising:

a section of waveguide in a state of tension;

a section of a rigid outer jacket spaced away from said waveguide; and

means at each of the ends of the rigid outer jacket for mechanically coupling said waveguide to said jacket while simultaneously maintaining said waveguide in said state of tension.

2. A structure according to claim 1 wherein the space between said waveguide and said rigid jacket is filled with a material to reduce sag in the waveguide from gravity, said material being sufficiently flexible that the tension on the waveguide will keep it substantially straight despite small deflections on the rigid jacket.

3. A waveguide structure comprising:

a section of waveguide in a state of tension;

a section of a rigid outer jacket spaced away from said waveguide; and

means at each of the ends of the rigid outer jacket for mechanically coupling said waveguide to said jacket while simultaneously maintaining said waveguide in said state of tension.