

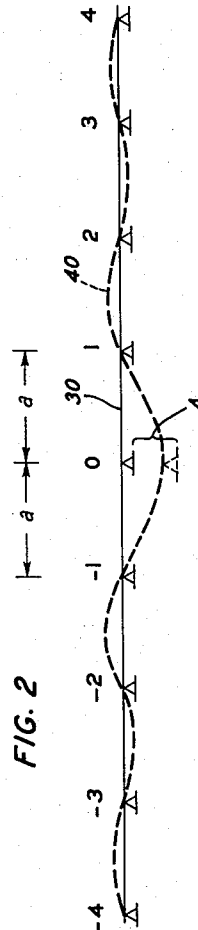
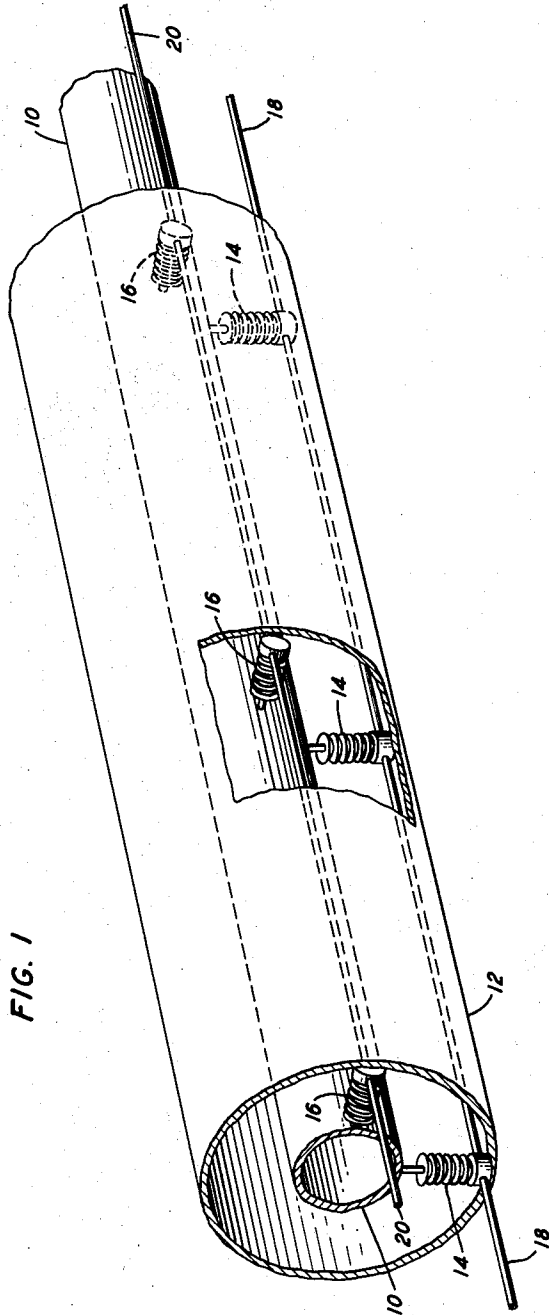
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SELF REALIGNING WAVEGUIDE SUPPORT SYSTEM

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SELF REALIGNING WAVEGUIDE SUPPORT
SYSTEM

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1 Claim. (Cl. 333-95)

This invention relates to a method and a system for supporting a waveguide transmission line. More particularly, it relates to a method and system for supporting a waveguide transmission line on a terrain which may be subject to localized disturbances such as vibration, lateral faulting, and vertical faulting commonly called heaving when the terrain rises, or settling when it recedes.

Waveguide transmission lines comprising copper pipe of circular cross section are deemed feasible for use as extremely broad frequency band transmission media with long distance communication systems, for example, for transcontinental communication systems. Reference may be had to an article entitled "Waveguide as a Communication Medium," by S. E. Miller, published in the Bell System Technical Journal, volume 33, No. 6, November 1954, for a discussion of numerous problems involved in the use of waveguide transmission lines. Among numerous other requirements for satisfactory service such a transmission line must be adequately protected from vibration caused by railways, heavy motor vehicle highway traffic, industrial plant vibration and the like which may affect localized portions of the terrain traversed by the transmission line. Such a line must further not be subjected to misalignment or to strains exceeding the elastic limit of the pipe as a result of vertical faulting which may comprise settling or heaving and lateral faulting or other disturbances of portions of the terrain upon which the line is supported. By way of illustration, swampy terrain may heave and settle, shale and similar strata may be subject to lateral as well as vertical faulting and in some locations earth tremors and other disturbances may be not infrequent.

A principal object of the invention is, accordingly, to eliminate the deleterious effects of vibration and other disturbances of the supporting terrain of long distance waveguide transmission lines.

A further object is to reduce the likelihood that waveguide transmission lines may be subjected to injurious misalignment or stresses as a result of disturbances of the supporting terrain.

This object is achieved in accordance with the principles of the present invention by supporting the waveguide transmission line on a fluid suspension system comprising in one form a plurality of fluid-filled flexible members which can be, for example, metallic or composition bellows, spaced along the waveguide as supporting elements, the members being interconnected by a tube or conduit and the members and conduit being initially filled with gas or other fluid at a predetermined pressure. Such a supporting system can be readily designed to effectively attenuate most vibrational frequencies likely to be encountered. It will further tend to reduce strains caused by localized heaving, settling or lateral faulting of the terrain by effecting a minor realignment of the waveguide in the vicinity of the disturbing influence through a redistribution of the fluid in the system between the supporting members in that vicinity as will be discussed in more detail hereinafter.

The above and other objects as well as additional features and advantages of arrangements of the invention will become apparent from a perusal of the following detailed description of a specific arrangement, illustrative

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of the application of the inventive principles and diagrammatically represented in the accompanying drawing, in which:

FIG. 1 indicates in diagrammatic form an arrangement embodying the principles of the invention; and

FIG. 2 is a diagram illustrative of the deformation of a waveguide as one of a plurality of supports recedes from the guide.

In more detail in FIG. 1, a waveguide transmission line 10, which can, for example, be a copper tube, is supported within a protective steel sheath tube 12. In accordance with the principles of the present invention a first row of vertically oriented flexible fluid-filled bellows 14 provides support on sheath 12 for the waveguide against the force of gravity and vertical components of other forces to which the waveguide may be subjected, and a second row of horizontally oriented flexible fluid-filled bellows 16 provides support from sheath 12 for the waveguide against horizontal forces and horizontal components of forces to which the waveguide may be subjected. Bellows 14 and 16 can be of copper or brass or alternatively of a tough rubber composition or the like.

A tube or conduit 18 connects to the interiors of the vertical row of bellows 14 through their respective bases and a tube or conduit 20 connects to the interiors of the horizontal row of bellows 16 through their respective bases. Initially the two supporting systems, i.e. the row of vertical bellows 14 with its associated conduit 18 and the row of horizontal bellows 16 with its associated conduit 20, are each filled with a fluid at a predetermined pressure and the systems are then sealed against leakage of fluid from them. While a liquid could be used as the fluid for these systems, a gas has the advantage of providing a greater cushioning effect and may afford more rapid redistribution of the fluid when required.

In the diagrammatic showing of FIG. 2, the undistorted waveguide (10 of FIG. 1) is represented by the straight full line 30 and successive points of support, as by bellows 14 of FIG. 1, for example, at regular intervals designated "a," to the left and right of the centermost support O are numbered from 1 to 4, respectively, those to the left of center being arbitrarily designated as being negative, as shown.

If it be assumed that the centermost support O recedes downwardly by a small amount, represented in exaggerated proportion by the designated distance Δ , because of settling of the terrain on which sheath 12 of FIG. 1 rests, the waveguide would initially tend to be distorted to a shape such as that indicated by the broken line curve 40. Obviously the effect of the disturbance at support O decreases rapidly to the left and right, becoming virtually imperceptible at less than ten times the distance "a" from support O. A redistribution of the fluid among the bellows at point O and its nearer neighbors 1 through 4 (or more) on each side of point O will tend to restore the waveguide to its original straight condition, the whole waveguide being lowered slightly to bring this about, thus compensating for the movement of the terrain at point O.

Proper design of the overall system then depends upon choosing parameters, i.e. capacity and spacing of bellows, size of connecting pipe or conduit, and original pressure in the system, such that for the largest amount of terrain displacement which is at all likely to take place along a particular section of the line the waveguide will not be initially subjected to any stress exceeding its elastic limit and redistribution of the fluid in the adjacent supporting bellows will restore the waveguide to a straight condition within a distance of its original position such that residual stresses at the ends of the realigned section

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of waveguide on neighboring sections to right and left will be within acceptable tolerance limits.

By way of a specific example, for a waveguide comprising a copper tube five inches in diameter with a wall thickness of one-eighth inch, for both vertical and horizontal supporting systems a bellows spacing "a" of ten feet, a bellows diameter of 1.5 inches, a bellows length of four inches, an interconnecting pipe or conduit one-quarter inch in diameter and an initial fluid pressure of 20 pounds per square inch were indicated as being suitable for a typical section of terrain along a transcontinental transmission line route, the section being subject to amounts of settling which are typical of normal topsoil motion, heaving and lateral faulting.

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:

In combination, a long distance waveguide transmis-

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sion line comprising a first cylindrical tube of highly conductive material adapted to transmit a very broad microwave frequency band of communication signals, a second cylindrical tube of strong resilient material having a diameter several times the diameter of the first tube and first and second supporting systems for the line, each supporting system comprising a plurality of flexible gas-filled members placed at intervals along the line to support the first tube coaxially within the second tube, and conduit means interconnecting all of the supporting members of the system, the first system providing support in the vertical plane, the second system providing support in the horizontal plane whereby the first tube will be isolated from mechanical shocks and vibration and displacement of the first tube as a result of terrain faulting at localized areas along the line will be minimized.

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