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WAVE GUIDE JOINT

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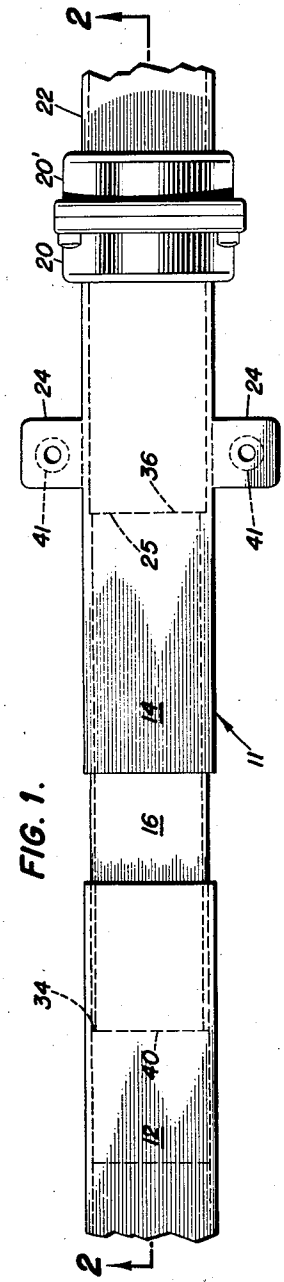


FIG. 1.

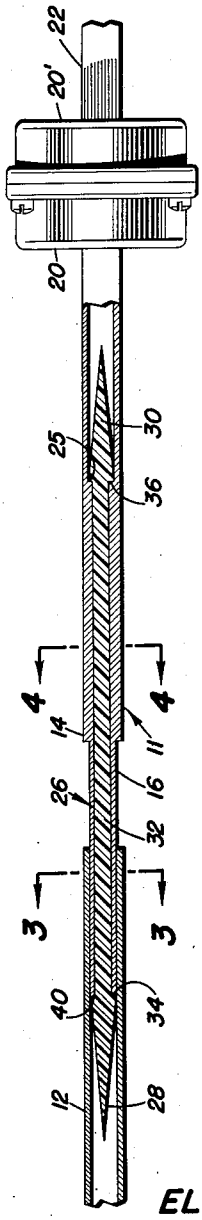


FIG. 2.



FIG. 4.

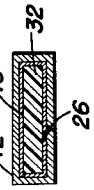


FIG. 3.

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WAVE GUIDE JOINT

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1 Claim. (Cl. 333—98)

The present invention relates to waveguide joints and more particularly to waveguide slip joints.

Heretofore, in certain applications of waveguide transmission lines, wherein the waveguide is secured to a supporting structure having a different thermal expansion coefficient from that of the waveguide, variations in temperature have caused warping or rupturing of the waveguide. This distortion of the waveguide is an effect of differential expansion existing between the waveguide and the supporting structure. An example of the principle of differential expansion is found in the bi-metallic strip forming the operating mechanism in certain thermostatic control devices. Variations in temperature can there be seen to cause a bowing of the bi-metallic strip. Similarly, under the aforementioned conditions, the waveguide can be seen to bow and frequently break. Transmission losses through the waveguide are accordingly increased, even to the point of complete attenuation of the transmitted signal.

Therefore, it is an object of this invention to provide a waveguide joint which will allow for thermally induced changes in the length of the waveguide.

Another and more specific object of the present invention is to provide a waveguide slip joint which will permit expansion or contraction of the accompanying waveguide by means of a slidable connection with preserves the electrical characteristics of the waveguide.

Still another object of this invention is to provide a waveguide slip joint having the above-mentioned features, and which is also free from mechanical vibrations so as to avoid the introduction of spurious noise into the waveguide system.

Further objects and attendant advantages of this invention will become evident from the following detailed description, taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a plan view of a waveguide joint according to the present invention, illustrating a portion of a waveguide connected to said joint;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 2; and

Fig. 4 is a section on line 4—4 of Fig. 2.

Briefly, the invention comprises a slip joint having a metallic wall fastened at one end to a first or supply waveguide and having its other end received in a second or receiving waveguide. To permit sliding motion while maintaining a continuous electrical path, the metal wall of the slip joint has a reduced portion of suitable outside dimension to be freely received inside the second or receiving waveguide. The change in the cut-off wavelength that would normally be encountered by the waves as they pass through the reduced section is compensated for by filling the reduced section with suitable dielectric. Impedance matching means are provided to accomplish the transition from dielectric filled waveguide to air filled waveguide without appreciable loss.

Referring to Fig. 1, there is shown a slip joint 11 connected to the receiving waveguide, shown at 12. The joint

11 comprises a metal shell 14 having a reduced end portion 16, of suitable outside dimension to be slidably received in the waveguide 12. At its other end the slip joint 11 is provided with a flange 20 for interconnecting the joint 11 with the supply waveguide, indicated at 22 and provided with a cooperating flange 20'. The slip joint 11 is also provided with projecting lugs 24 for mounting purposes.

As can be seen in Fig. 2, the inside dimension of shell 14 is reduced providing a shoulder 25 to form the reduced portion 16. Inserted in the slip joint 11 is a rod 26 of Teflon (polytetrafluoroethylene) or other dielectric having wedge-shaped end sections 28 and 30 and a reduced intermediate portion 32 defining shoulders 34 and 36. The wedge 28 is received in waveguide 12 while wedge 30 is carried in the slip joint 11. The intermediate portion 32 of Teflon rod 26 is uniform in cross section throughout its length, the shoulders 34 and 36 at the ends of the intermediate portion 32 being formed by the difference in cross section occasioned by the presence of wedges 28 and 30. The shoulder 36 bearing against the shoulder 25 on the inside surface of the slip joint shell 14, and the shoulder 34 abutting the termination 40 of the reduced portion 16 of the slip joint shell, hold the Teflon rod 26 firmly in place. As seen in Figs. 3 and 4, the intermediate portion 32 of Teflon rod 26 completely fills the inside of the reduced portion 16 of the slip joint extending from shoulder 25 to the termination 40.

Again referring to Fig. 2, the reduced portion 16 of shell 14 is dimensioned so as to snugly but slidably fit within the receiving waveguide 12. The shell 14 extends beyond wedge 30 of rod 26 and at its termination has the flange 20 which provides a convenient means for connecting the slip joint 11 to the supply waveguide 22. The portion of shell 14 extending from the shoulder 25 to the flange 20 is of the same cross section as the supply waveguide 22 and, in effect, constitutes an extension thereof.

The wedges 28 and 30 serve to match the impedance of the waveguide sections having an air dielectric to that portion of the joint having a Teflon dielectric. It will be understood that the slope of the wedges 28 and 30 is not critical, the general rule being that longer wedges are accompanied by lower insertion losses. A practical limitation is imposed upon the length of the wedge, however, in that the wedge must not be so long as to be structurally weak and thus introduce spurious noise when the joint is subjected to vibrations.

The intermediate section formed by the reduced portion 16 is filled with dielectric 26 and possesses a different characteristic impedance from that of the adjacent air filled waveguide, due to the altered dimensions and different dielectric constants. Ordinarily, the interposition of a portion of waveguide having a characteristic impedance differing from the characteristic impedance of the adjoining waveguide would result in poor transmission efficiency throughout the waveguide due to reflections from the interposed section. The present invention overcomes this difficulty by the provision of the impedance matching wedges 28 and 30. Wedge 30 provides a smooth transition from the impedance characteristic of the supply waveguide to the impedance characteristic of the reduced portion 16 of joint 11. Thereafter, wedge 28 provides similarly, a smooth transition from the impedance characteristic of the reduced portion 16 to the impedance characteristic of the receiving waveguide 12. Thus, the value of the characteristic impedance for the portion 16 is immaterial, for it is evident that the supply waveguide 22 can be considered to be terminated in its characteristic impedance. Likewise, the portion 16 is both supplied by and terminated in its characteristic impedance, while the receiving waveguide 12 appears to be excited from a source having a characteristic impedance equal to its own.

A secondary function of the Teflon rod **26** is the lowering of the cut-off frequency of the reduced portion **16**. This property is beneficial in maintaining the transmission characteristics of the joint **11** inasmuch as a reduction in the cross section of a waveguide increases the cut-off frequency. Therefore, the property of the Teflon dielectric in lowering the cut-off frequency compensates for the increase in cut-off frequency engendered by the reduction in cross section of portion **16**.

In operation, the flange **20** is connected to a supply waveguide **22** and the reduced end portion **16** is inserted into the receiving waveguide **12**. The joint **11** is secured to a suitable mounting structure by screws passed through holes **41** in the mounting flanges **24**. The receiving waveguide can then change in length according to temperature variations without the introduction of stresses tending to deform the waveguide. Compensation for variations in the length of the receiving waveguide are accomplished by the slippage of the reduced end portion **16** of the joint **11** within the receiving waveguide **12**, the penetration of the joint into the receiving waveguide being greatest when the receiving waveguide is longest.

The joint **11** accomplishes its intended purpose without the introduction of significant transmission losses. In this respect it should be noted that the wedges **28** and **30** efficiently couple the Teflon dielectric portion of the joint with the air dielectric portions of the waveguide and joint and that all changes in length of the waveguide occur externally of the electrical path so that the length of the electrical path through the waveguide remains substantially unchanged as the temperature is varied.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

A waveguide slip joint for slidably interconnecting a pair of adjacent waveguides, comprising a metallic shell having an interior similar in cross section to said adjacent waveguides and one portion thereof corresponding in cross section to said adjacent waveguides and a second portion thereof reduced in cross section from said adjacent waveguides and said shell having an end portion of the exterior thereof adapted to slidably fit within one of said waveguides and carrying means on the opposite end for rigidly connecting said shell to the other of said waveguides, a solid dielectric rod completely filling said reduced interior, a first dielectric wedge carried on one end of said dielectric rod and extending within the interior of said shell, and a second dielectric wedge carried on the other end of said dielectric rod and projecting beyond the end of said shell.

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