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[54] **TUNING STRUCTURES FOR MICROSTRIP TRANSMISSION LINES**

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[52] **U.S. Cl.** ..... **333/82 B;** 333/24 C; 333/84 M

[51] **Int. Cl.**[2] **H01P 7/00;** H01P 1/20

[58] **Field of Search** ..... 333/24 C, 73 S, 82 B, 84 R, 333/84 M, 12

[56] **References Cited**

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[57] **ABSTRACT**

Two embodiments are disclosed to tune microstrip transmission lines. One embodiment includes a stub strip conductor disposed on the microstrip transmission line substrate at right angles with respect to and spaced from the strip conductor of the microstrip transmission line and a tuning member at right angles to the substrate disposed over the gap between the stub strip conductor and the strip conductor. When the distance of the tuning member above the substrate is varied the shunt impedance of the microstrip transmission is varied. The other embodiment includes a tuning member threaded in a hole through the carrier of the microstrip transmission line with the metallization removed from the ground plane of the microstrip transmission line immediately above the hole. The inward and outward movement of the tuning member provides a variable series impedance for the microstrip transmission line.

3 Claims, 4 Drawing Figures

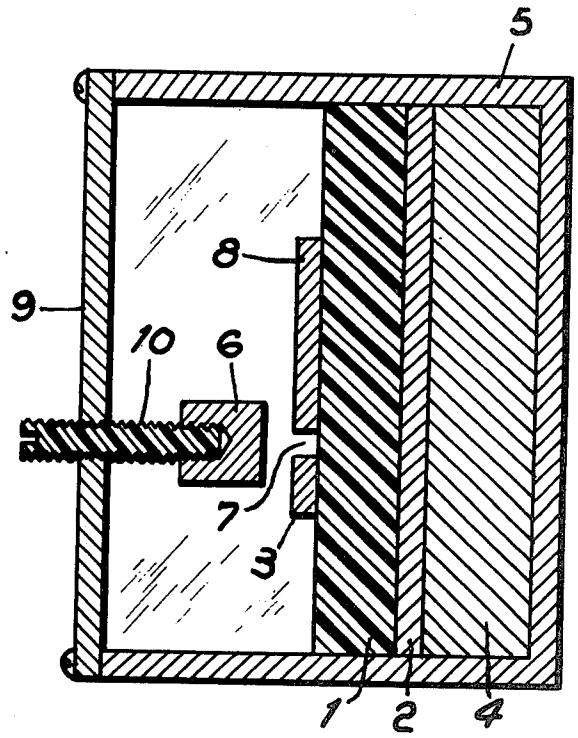


Fig. 1

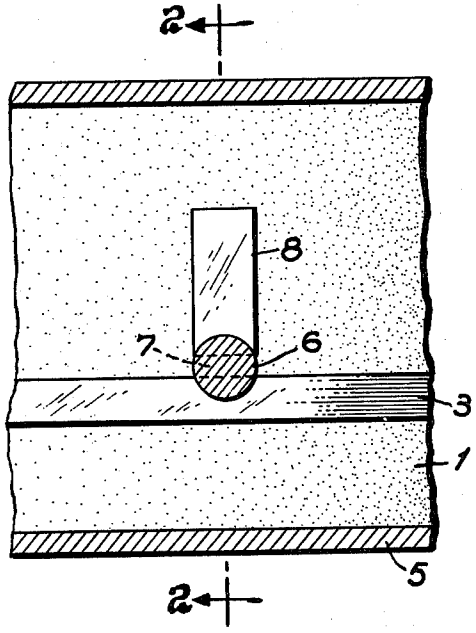


Fig. 2

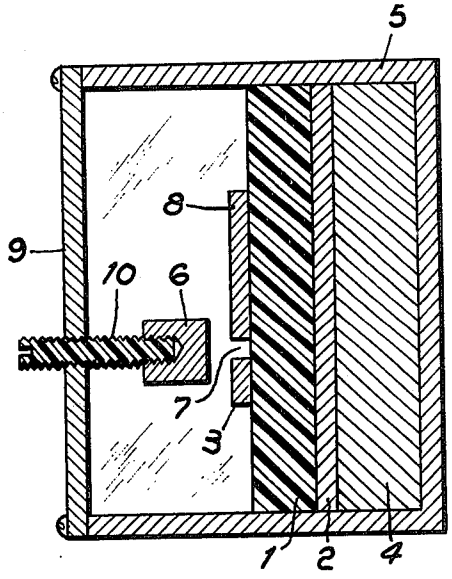


Fig. 3

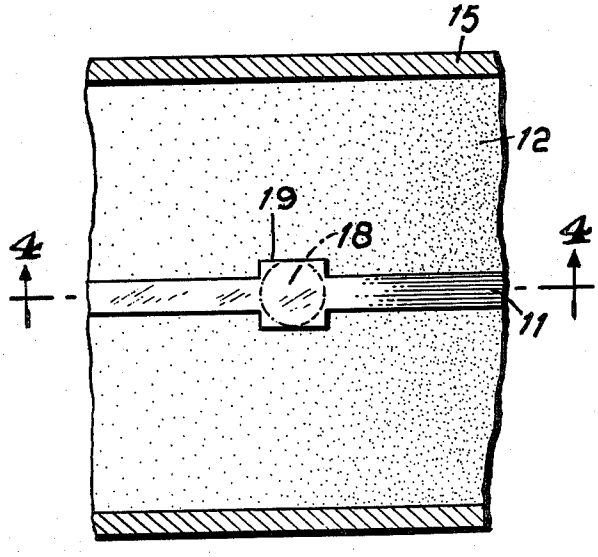
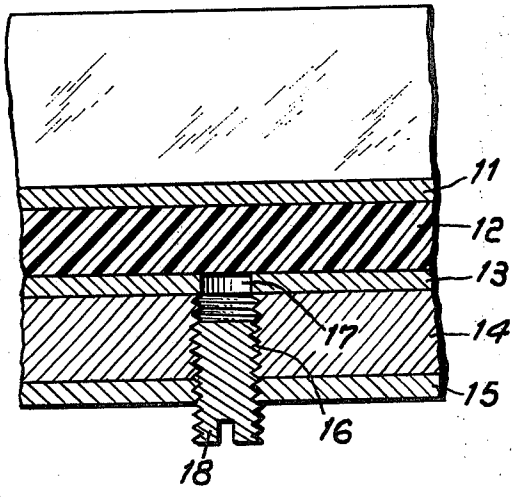


Fig. 4



TUNING STRUCTURES FOR MICROSTRIP TRANSMISSION LINES

BACKGROUND OF THE INVENTION

This invention relates to microwave transmission lines, and more particularly to tuning structures for a microstrip transmission line.

SUMMARY OF THE INVENTION

An object of the present invention is the provision of a structure to change an impedance of a microstrip transmission line and thereby tune this transmission line.

Another object of the present invention is the provision of a structure to change the shunt impedance of the microstrip transmission line and thereby tune this transmission line.

Another object of the present invention is the provision of a structure to vary the series impedance of a microstrip transmission line and thereby tune this transmission line.

A feature of the present invention is to provide a tuning structure for a microstrip transmission line comprising: a substrate; a ground plane disposed on one surface of the substrate; a strip conductor disposed on the other surface of the substrate superimposed with respect to the ground plane, the substrate, the ground plane and the strip conductor providing the microstrip transmission line; a carrier in association with the ground plane to support the microstrip transmission line; and an arrangement including a tuning member associated with the strip conductor and capable of moving in a perpendicular relationship with respect to the substrate to change an impedance of the microstrip transmission line and thereby tune the microstrip transmission line.

BRIEF DESCRIPTION OF THE DRAWING

Above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a top plan view with the enclosure cover removed of one embodiment of a tuning structure for tuning a microstrip transmission line in accordance with the principles of the present invention;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a top plan view with the enclosure cover removed of a second embodiment of a tuning structure for tuning a microstrip transmission line in accordance with the principles of the present invention; and

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, there is disclosed therein a tuning structure for tuning a microstrip transmission line in accordance with the principles of the present invention. The microstrip transmission line is a conventional microstrip transmission line manufactured by any of the well known printed circuit techniques and includes a substrate 1, ground plane 2 disposed on one surface of substrate 1 and strip conductor 3 disposed on the other surface of substrate 1. When this transmission line is incorporated in assemblies and subassemblies of an electronic system, such as a radio transmitter or receiver, a metallic carrier 4 is provided to support the microstrip transmission line in enclosure 5. The tuning structure is provided by an arrangement including a tuning member 6 suspended above gap 7 between strip conductor 3 and stub strip conductor 8 disposed on substrate 1 at right angles with respect to strip conductor 3. Stub strip conductor 8 can be formed upon substrate 1 employing any of the well known printed circuit techniques. When member 6 is varied in distance from substrate 1 in a direction perpendicular thereto the capacitance across the gap 7 is varied and the total stub impedance presented to the microstrip transmission line varies. Thus, a variable shunt impedance is created which will enable tuning the microstrip transmission line.

Tuning member 6 may be a dielectric rod threaded in cover 9 of enclosure 5 but preferably tuning member 6 is metallic as illustrated enabling a more efficient tuning of the microstrip transmission line. Member 6 may be a continuous member screwed into a threaded aperture in cover 9 for movement perpendicular to substrate 1 or as illustrated member 6 may be threaded on to a dielectric rod 10 which in turn is screwed into a threaded aperture in cover 9.

The enclosure 5 with its cover 9 is employed in a conventional manner to isolate the microstrip transmission line from other electrical components of the overall system in which it is included. This isolation prevents radio frequency energy from leaking from the microstrip transmission line which may have detrimental effects upon other radio frequency components of the system. Also, the isolation provided by enclosure 5 and its cover 9 prevents radio frequency energy from other radio frequency components from interferring with the operation of the microstrip transmission line.

Referring to FIGS. 3 and 4, there is disclosed therein a second embodiment of a tuning structure for tuning a microstrip transmission line in accordance with the principles of the present invention. As in FIGS. 1 and 2, the microstrip transmission line is manufactured by employing any one of the known printed circuit techniques and includes a strip conductor 11 deposited on one surface of substrate 12 and ground plane 13 deposited on the other surface of substrate 12. When incorporated into an assembly or a subassembly of an overall system, the microstrip transmission line is supported by a carrier 14 within an enclosure 15. A threaded hold 16 is provided in carrier 14 and enclosure 15 and at the same time ground plane 13 is removed from substrate 12 at region 17 to provide an extension of hole 16 to the bottom of the substrate 12. A screw 18 is threaded into hole 16. As screw 18 is moved in and out of carrier 14, the flux path to ground from the microstrip transmission line above the screw is shortened and lengthened. This changes the capacitance of the microstrip transmission line immediately above screw 18 and hence the characteristic impedance Z_o of the microstrip transmission line which has a value given approximately by the following formula:

$$\frac{Z_o}{\text{Unit length}} = \frac{1}{(\text{phase velocity}) \times \frac{(\text{capacitance})}{(\text{unit length})}}$$

The affect of this arrangement is to create a variable impedance in series with the transmission path of the microstrip transmission line and hence a variable series impedance for the microstrip transmission line which will enable tuning this transmission line.

Since screw **18** has a diameter greater than the width of strip conductor **11** a portion **19** of conductor **11** in operative association with screw **18** is widened to a width equal to the diameter of screw **18** and portion **19** has a length equal to the diameter of screw **18** to provide a more efficient control of the series impedance.

The enclosure **15** of this arrangement has the same purpose as enclosure **5** of the arrangement of FIGS. **1** and **2.**

While I have described above the principles of my invention in connection with specific apparatus it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. A tuning structure for a microstrip transmission line comprising:

a substrate;

a ground plane disposed on one surface of said substrate;

a strip conductor disposed on the other surface of said substrate superimposed with respect to said ground plane, said substrate, said ground plane and said strip conductor providing said microstrip transmission line;

a carrier in association with said ground plane to support said microstrip transmission line;

an arrangement including a tuning member associated with said strip conductor and capable of moving inward and outward in a perpendicular relationship with respect to said substrate to change an impedance of said microstrip transmission line and thereby tune said microstrip transmission line; and

an enclosure for said transmission line, said carrier and said arrangement to provide a radio frequency interference shield therefore;

said arrangement further including

a stub strip conductor disposed on said other surface of said substrate spaced from and at right angles to said strip conductor, the spacing of said stub strip conductor and said strip conductor

provides a gap in operative association with said tuning member, said tuning member varying a capacitance across said gap and thereby the total shunt impedance presented to said microstrip transmission line.

2. A tuning structure according to claim **1,** wherein said tuning member is metallic.

3. A tuning structure for a microstrip transmission line comprising:

a substrate;

a ground plane disposed on one surface of said substrate;

a strip conductor disposed on the other surface of said substrate superimposed with respect to said ground plane, said substrate, said ground plane and said strip conductor providing said microstrip transmission line;

a carrier in association with said ground plane to support said microstrip transmission line;

an arrangement including a tuning member associated with said strip conductor and capable of moving inward and outward in a perpendicular relationship with respect to said substrate to change an impedance of said microstrip transmission line and thereby tune said microstrip transmission line; and

an enclosure for said transmission line, said carrier and said arrangement to provide a radio frequency interference shield therefore;

said arrangement further including

a hole at right angles to said substrate through said carrier, said enclosure and said ground plane;

said tuning member being inserted in said hole to change the length of flux paths to ground from said microstrip transmission line and thereby the series impedance of said microstrip transmission line immediately above said tuning member;

said hole being threaded, and

said tuning member being a metallic screw screwed into said threaded hole;

said screw having a diameter greater than the width of said strip conductor, and

a portion of said strip conductor in operative association with said screw being widened to a width equal to the diameter of said screw, said portion having a length equal to the diameter of said screw.

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