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RIGHT ANGLE COAXIAL TO STRIP LINE TRANSITION

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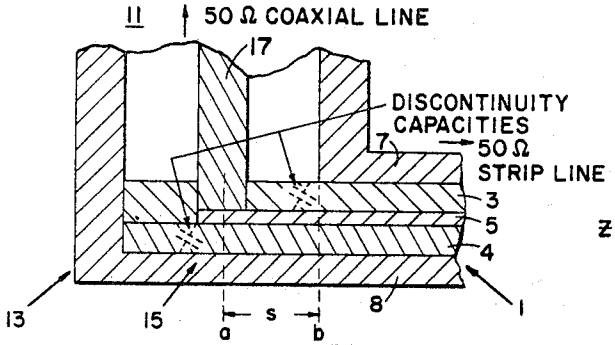


FIG. 1 PRIOR ART

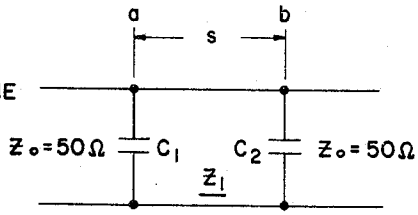


FIG. 2

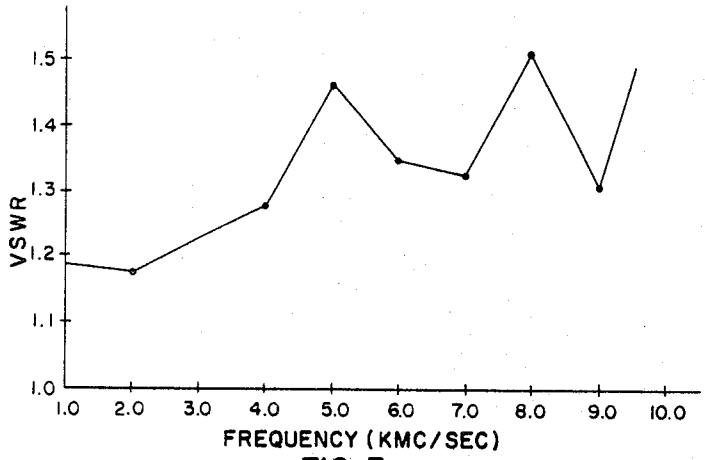


FIG. 3

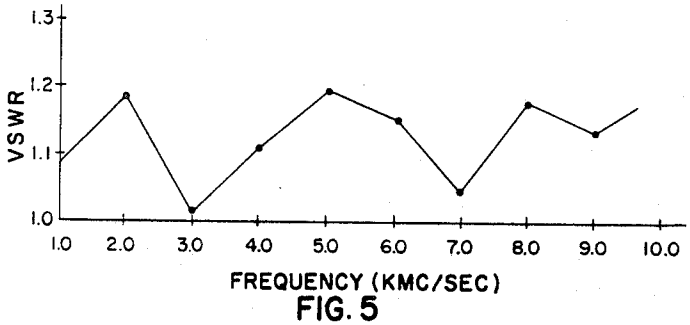


FIG. 5

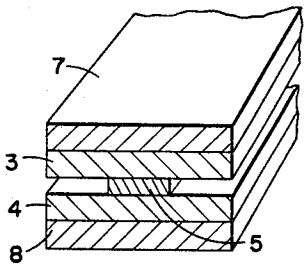


FIG. 6

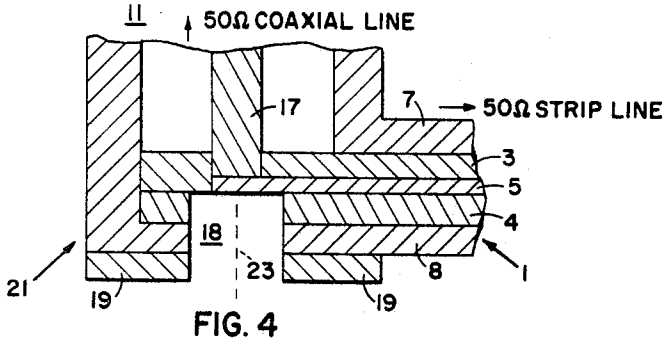


FIG. 4

John Mattern
Joseph A. Kempic,
INVENTORS.
BY Edward J. Kelly
Herbert Berl
Albert C. Jenks
ATTORNEYS

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RIGHT ANGLE COAXIAL TO STRIP LINE TRANSITION

John Mattern, Baltimore, and Joseph A. Kempic, Ellicott City, Md., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Army

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ABSTRACT OF THE DISCLOSURE

A circular hole is provided in the dielectric and ground plane of a strip line. The hole has its radius about a center line drawn through the center conductor of a coaxial line joined to the strip line. The radius of the hole is in general a little less than one-half of the inside radius of the coaxial line and will cause a compensating E field reflection.

The construction of a strip line whose physical size is kept as small as possible consistent with reasonable electrical performance has presented many problems. The line must have good power handling capacity, moderately low attenuation, and a shape such that it can fit in confined spaces. It can be seen from all this, that size, fabrication, and electrical requirements are all interrelated, and an improvement in one can result in a disimprovement in another.

The wide variety of uses to which strip lines can be applied has been long established. It has been shown that the only limitations to the miniaturization of strip transmission lines are the tolerances on the thickness of commercially available materials and the ease with which the line can be fabricated. The simplicity of construction and the accuracy to which these components can be reproduced have amply demonstrated the practicality of this line type. However, in order to use these strip lines in connection with standard coaxial line equipment, a broadband coaxial line to strip line adapter is needed. For large strip line sizes, an adapter in which the strip line and coaxial line or cable lie along the same axis leads to simple adapters with excellent broad band characteristics. However, due to the extremely small dimensions of miniature strip lines, this type of construction proves to be unfeasible. Consequently, a right angle adapter has to be used. The use of a right angle adapter in the past has not given a suitably low voltage standing wave ratio (VSWR) over the entire frequency band.

It is therefore an object of this invention to improve a broadband coaxial line to strip line adapter.

A further object of the present invention is to provide a right angle adapter for miniature strip lines.

A still further object of the invention is in a right angle adapter which has a suitably low voltage standing wave ratio over the entire frequency band to be utilized.

The invention further resides in and is characterized by various novel features of construction, combinations, and arrangements of parts which are pointed out with particularlity in the claims annexed to and forming a part of this specification. Complete understanding of the invention and an introduction to other objects and features not specifically mentioned will be apparent to those skilled in the art to which it pertains when reference is made to the following detailed description of a specific embodiment thereof and read in conjunction with the appended drawing. The drawing, which forms a part of the specification, presents the same reference characters to represent corresponding and like parts throughout the drawing, and wherein:

FIGURE 1 shows a cutaway view of a broadband coaxial line to strip line right angle adapter;

FIGURE 2 illustrates a schematic showing of an approximate equivalent circuit for the adapter of FIGURE 1;

FIGURE 3 illustrates the relationship between the VSWR and frequency of the adapter of FIGURE 1;

FIGURE 4 shows a cutaway view of an adapter according to the present invention;

FIGURE 5 illustrates the relationship between the VSWR and frequency of the adapter of FIGURE 4; and

FIGURE 6 shows a cutaway perspective view of the strip line.

A strip line **1** whose physical size is kept as small as possible consistent with reasonable electrical performance is presented in FIGURES 1, 4 and 6. This line is fabricated in such a manner that it can be shaped to fit into relatively confined spaces. Such a line has good power handling capacity and moderately low attenuation. Strip line **1**, as well as coaxial line **11**, has a characteristic impedance of 50 ohms and operates over a frequency band extending from 100 mc./sec. to 13,000 mc./sec. The center conductor **5** is sandwiched in between an upper dielectric **3** and a lower dielectric **4**. The outer conductors or ground planes **7** and **8** sandwich both the dielectrics and the center conductor. Upper ground plane **7** and lower ground plane **8** may be made of copper, silver or Nichrome. The center conductor **5** may also be made of copper, silver or Nichrome. The strip line **1** is connected to a 50 ohm coaxial line **11** by a right angle adapter indicated generally at **13** in FIGURE 1.

The adapter **13** is simply constructed as shown in FIGURE 1, and its length in either the coaxial or strip line direction may be of any convenient length. The coaxial to strip line right angle transition has an approximate equivalent circuit as shown in FIGURE 2. A section of unbalanced strip line characteristic impedance Z_1 is indicated generally as reference numeral **15**. Discontinuity capacities C_1 and C_2 make up the circuit. The impedance of the lines are indicated by Z_0. A typical VSWR vs. frequency curve for a pair of these transitions is shown in FIGURE 3. The extended center conductor **17** of coaxial line **11** is thought to produce a reflection because of a partial short circuit of the electrical (E) field at the end of the strip line. This is undesirable as it causes the VSWR to become larger.

In order to eliminate the E field reflection, a compensation reflection has to be produced. In FIGURE 4 such a compensating reflection is produced by the removal of part of the solid dielectric **4** and ground plane **8** opposite center conductor **17** as shown. A hole or gap **18** causes a reflection of opposite polarity to that of the E field reflection. Pressure plate **19** is provided to hold the adapter **21** in place. The VSWR vs. frequency curve for the adapter of FIGURE 4 is shown in FIGURE 5. It can readily be seen from a comparison of the unmodified adaper curve in FIGURE 3 with the curve of the modified adapter shown in FIGURE 5 that a significant reduction of reflection from each transition is obtained. This gives the advantage, of course, of a reduced VSWR resulting from the wide band compensation of the E field reflection inherent in these transitions.

The hole giving optimum results is a circular hole **18** having its radius about an axis **23**. The axis is located by a center line drawn through center conductor **17** of the coaxial line. Where the inside radius (s) of the coaxial line is 0.138 inch, the hole size giving optimum results is approximately 0.0575 inch in radius. The radius of the hole should in general be a little less than one-half of the inside radius of the coaxial line, but greater than the radius of the center conductor of the coaxial line or cable.

A preferred embodiment of the invention has been chosen for purposes of illustration and description. The preferred embodiment illustrated is not intended to be exhaustive nor to limit the invention to the precise form disclosed. It is chosen and described in order to best explain the principles of the invention and their application in practical use to thereby enable others skilled in the art to best utilize the invention in various embodiments and modifications as are best adapted to the particular use contemplated. It will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention as set forth in the disclosure, and that in some cases, certain features of the invention may sometimes be used to advantage without a corresponding use of other features. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described. Accordingly, it is desired that the scope of the invention be limited only by the appended claims.

We claim:

1. An adapter comprising a coaxial line and a strip line in which both the coaxial line and the strip line have a center conductor and an outer conductor; said center conductors being connected to each other at an angle; said outer conductors being connected to each other at an angle; said outer conductor of the strip line having an opening where the center conductors are connected; said strip line further having an upper and a lower dielectric; said dielectrics sandwiching the center conductor of the strip line; said center conductor of the coaxial line passing through the upper dielectric to make contact with the center conductor of the strip line; and the lower dielectric having an opening which has a center about a center line of the center conductor of said coaxial line.

2. An adapter as set forth in claim **1**, wherein the strip line has upper and lower ground planes for its outer conductor; and wherein said lower ground plane and the lower dielectric have said openings therein which are equal and have a center about a center line of the center conductor of said coaxial line.

3. An adapter as set forth in claim **2**, wherein said angles are right angles.

4. An adapter as set forth in claim **2**, wherein said openings have a circular cross-section.

5. An adapter as set forth in claim **4**, wherein said openings each have a diameter less than an inside diameter of the coaxial line but greater than a width of the center conductor of the coaxial line.

6. An adapter as set forth in claim **5**, further comprising a pressure plate connected below the openings.

7. An adapter as set forth in claim **6**, wherein said pressure plate has an opening therein the same as the openings of the lower dielectric and the lower ground plane.

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HERMAN KARL SAALBACH, *Primary Examiner.*

PAUL L. GENSLER, *Examiner.*