April 5, 1966 C. O. FORGE 3,245,013

STRIP LINE TO COAXIAL TRANSITION

Filed Dec. 23, 1964

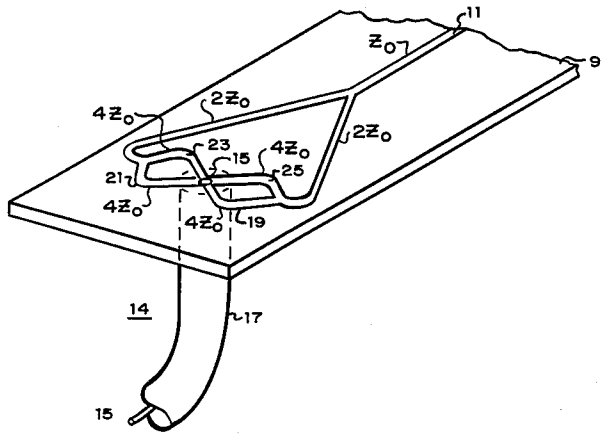


Figure 1

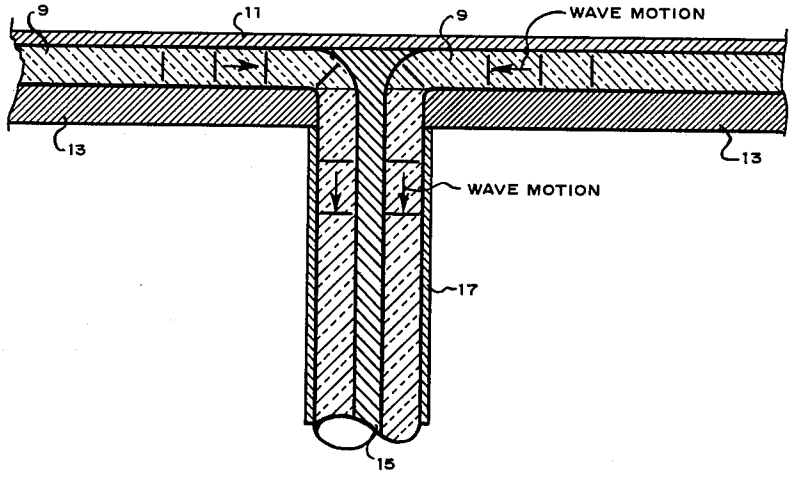


Figure 2

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STRIP LINE TO COAXIAL TRANSITION

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This invention relates to means for coupling a strip line to a coaxial line to provide a low reflection transition.

It is an object of the present invention to provide apparatus for reducing discontinuities in the electric field distribution about the connection of a strip line to a coaxial line.

It is another object of the present invention to provide an improved, low reflection transition from strip line to coaxial line.

In accordance with the illustrated embodiment of the present invention, the center conductor of a coaxial line terminates near the plane of a strip line. The strip line is divided into n number of secondary strip lines, each of which divides into m number of auxiliary strip lines which are radially disposed about and in contact with the center conductor of the coaxial line. The mean signal path lengths from the center conductor through the auxiliary and secondary strip lines to the main strip line are equal.

These and other objects will be apparent from a reading of this specification and inspection of the accompanying drawing in which:

FIGURE 1 is a perspective view of the transition from strip line to coaxial line; and

FIGURE 2 is a sectional view of the transition of FIGURE 1.

Referring now to the figures of the drawing, there is shown a slab of dielectric material **9** supporting a conductor **11** above a ground plane **13** to form a strip line electric wave conductor having a characteristic impedance Zo. A coaxial cable **14** including inner conductor **15** and outer conductor **17** is disposed normal to the strip line with the inner conductor **15** terminating about in the plane of the conductor **11**. The outer conductor **17** is connected to the ground plane **13**. A plurality of auxiliary strip lines **19**, **21**, **23** and **25**, each having a characteristic impedance $4Zo$, are radially disposed about the terminal end of center conductor **15** in contact with it. Pairs of the auxiliary strip lines combine in parallel to form secondary strip lines, each having a characteristic impedance of $2Zo$. The secondary lines combine in parallel and connect to the main strip line which has a characteristic impedance of Zo. The radial orientation of the auxiliary lines **19–25** about the center conductor **15** enables an electric signal wave to propagate radially along the lines and hence establish at their junction with conductor **15** a radial electric field similar to the field which exists in the coaxial cable **14** about the center conductor. The field transition may be improved further by rounding the corner of the ground conductor connection and by radially filleting the center conductor **15** near the contact with strip conductor **11**, as shown in FIGURE 2. Also, the mean signal path length from

the terminal end of the center conductor **15** along the auxiliary and secondary strip lines to the main strip line are all equal, thus eliminating out-of-phase signal cancellation and mismatch. It should be understood that other configurations using various numbers of auxiliary strip lines, say five or eight, radially disposed about the center conductor may also be used in accordance with the present invention.

Therefore, the transition from strip line to coaxial line according to the present invention decreases signal reflections and signal losses by shaping the electric field about the strip line near the transition to conform to the electric field in the coaxial line and by maintaining the mean signal path lengths substantially equal.

I claim:

1. Electrical conductor connection apparatus comprising:

a main strip line electric wave conductor including a ground conductor and having a characteristic impedance;

a coaxial line electric wave conductor including a center conductor and an outer conductor;

said main strip line and coaxial line electric wave conductors being disposed in intersecting skew relationship;

means connecting together said ground conductor and said outer conductor;

a plural number, n, of auxiliary strip line electric wave conductors connected to said center conductor and radially disposed thereabout; and

means connecting said auxiliary strip lines to said main strip line.

2. Apparatus as in claim **1** wherein:

each of said auxiliary strip lines has a characteristic impedance equal to n times the characteristic impedance of the main strip line.

3. Electrical conductor connection appartus comprising:

a main strip line electric wave conductor including a ground conductor and having a characteristic impedance;

a coaxial line electric wave conductor including a center conductor and an outer conductor;

said main strip line and coaxial line electric wave conductors being disposed in intersecting skew relationship;

means connecting together said ground conductor and said outer conductor;

a plurality of auxiliary strip line electric wave conductors connected to said center conductor and radially disposed thereabout; and

secondary strip line electric wave conductors connecting selected ones of said auxiliary strip lines and said main strip line.

References Cited by the Examiner

UNITED STATES PATENTS

2,983,884	5/1961	Rueger	333—84
3,199,055	8/1965	Keen	333—84

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