Aug. 17, 1965 R. W. VOELCKER 3,201,721

COAXIAL LINE TO STRIP LINE CONNECTOR

Filed Dec. 30, 1963

FIG. 1

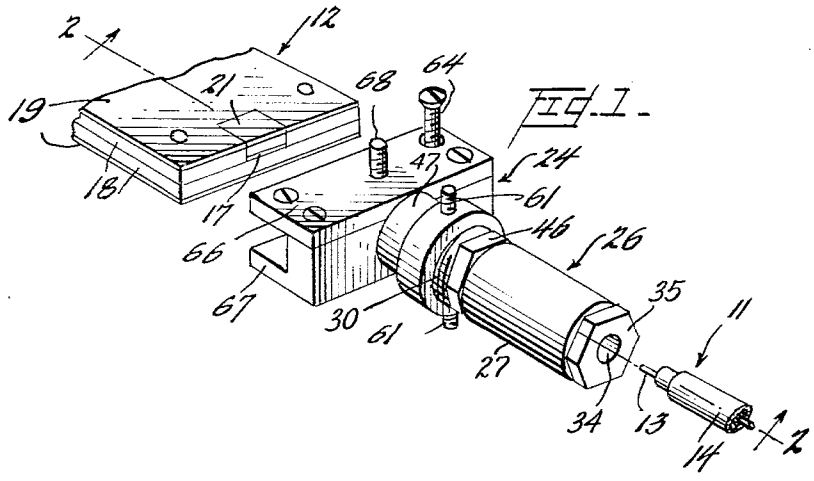
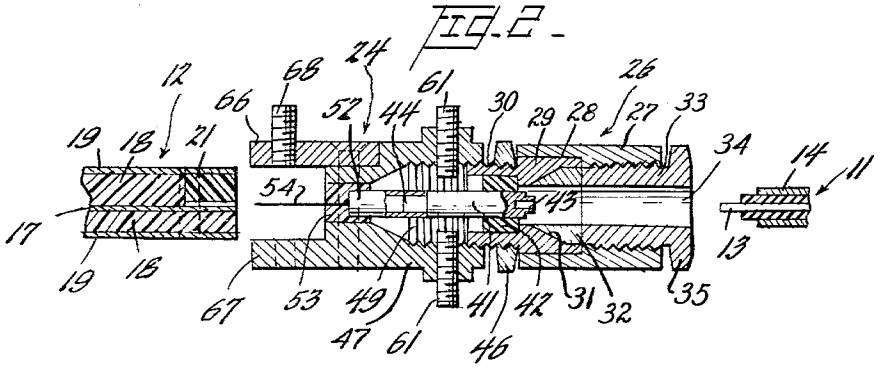


FIG. 2



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COAXIAL LINE TO STRIP LINE CONNECTOR

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6 Claims. (Cl. 333—33)

This invention relates to a coaxial line to strip line connector, and more particularly to a coaxial line to strip line connector having facilities for compensating for impedance mismatch and phase shift.

In certain applications, it is necessary to connect a coaxial transmission line (hereafter referred to as "coaxial line") to a strip transmission line (hereafter referred to as "strip line"). Usually as a result of such a connection, an impedance mismatch of the lines occurs and a phase shift is introduced into a signal being transmitted along the over-all line made up of the coaxial and strip lines. Sometimes impedance mismatch and phase shift are tolerable; however, in certain instances, it is critical that impedance mismatch and phase shift be corrected.

The usual procedure in the prior art for correcting this impedance mismatch and phase shift is to disconnect the lines from a connector and to machine the connector by trial and error; thereby altering the physical dimensions of the connector to adjust for impedance mismatch and phase shift. It is manifest that such a complicated procedure produces a connector tailored to operate only with a particular coaxial line and strip line.

The connector of this invention has adjustable facilities for compensating for impedance mismatch and phase shift. These adjustable facilities permit interchangeability of connectors and lines, compensation for impedance mismatch and phase shift without disconnecting the lines, and subsequent adjustments, if necessary, without complicated machining procedures.

An object of this invention is to provide a new and improved coaxial line to strip line connector.

Another object is to provide a coaxial line to strip line connector having facilities for compensating for impedance mismatch and phase shift.

With these and other objects in view, a coaxial line to strip line connector illustrating certain features of the invention includes a body portion having a cavity contained therein and facilities for connecting a coaxial line and a strip line thereto. Facilities are provided for tuning the cavity to correct for impedance mismatch and for adjusting the cavity to correct for phase shift.

Other objects and advantages of the invention will become apparent by reference to the following detailed specification and accompanying drawings, wherein:

FIG. 1 is a perspective view, incorporating certain principles of the invention, of a coaxial line to strip line connector having an upper body for receiving a coaxial line and a lower body for receiving a strip line; and

FIG. 2 is a cross sectional view of the coaxial line to strip line connector taken along line 2—2 of FIG. 1.

In FIGS. 1 and 2 there is shown the coaxial line to strip line connector (hereafter referred to as "connector") for connecting a coaxial line 11 and a strip line 12. Coaxial line 11 is representative of a wide variety of coaxial transmission lines and includes a center conductor 13 concentrically arranged within and electrically insulated relative to an outer conductor 14.

Strip line 12 is representative of a wide variety of strip transmission lines and includes a flat, center conductor 17 placed between a pair of dielectric sheets 18 which are secured to a pair of flat, outer conductors 19. Standard strip line 12 is modified in that a block or wedge 21 is removable from the top of strip line 12 and is aligned with center conductor 17.

The connector includes a lower body assembly 24 and an upper body assembly 26. Upper body assembly 26 comprises an outer sleeve 27 which is counterbored at 28 to receive a collar 29 from which extends a threaded projection 30. The collar 29 is force fitted, staked, or otherwise secured within the counterbored sleeve 27. The inner surface of the collar 29 is machined to form a wedging cone 31 into which is nested a split ferrule 32 having a conical outer surface. The sleeve 27 is provided with internal threads to receive an externally threaded inner sleeve 33 having an opening 34 and having one end formed in the shape of a bolt head 35.

An upper chuck 41 is mounted in a block 42 of electrical insulation secured within upper body assembly 26. Upper chuck 41 has a beveled end 43 which communicates with the interior of upper body assembly 26 and a pin 44 which extends beyond projection 30. A lock nut 46 threadably engages and is adjustable in position along projection 30.

Projection 30 of upper body assembly 26 is threaded into an internally threaded sleeve 47 forming a part of the lower body assembly 24 to define a tuning cavity 49. Tuning screws 61 extend through the walls of sleeve 47 and are adjustable in position within cavity 49. A lower chuck 52 is mounted in a block 53 of electrical insulation secured within the sleeve 47 of the lower body assembly 24. Lower chuck 52 has an opening which receives pin 44 of upper chuck 41 and a flat tab 54 extending out of lower body assembly 24.

Clamping screws 64 are threadable through holes in legs 66 and 67 which extend from the sleeve 47 of the lower body assembly 24 (FIGS. 1 and 2). Clamping screws 64 are aligned with holes in the end of strip line 12. A locking screw 68 (FIGS. 1 and 2) is threadable through leg 66 and is aligned with tab 54

The connector is made of electrically conductive material except for the insulation blocks 42 and 53 to define a first conductive path through upper body assembly 26 and lower body assembly 24, and a second conductive path through upper chuck 41.

Operation

In the operation of the connector, coaxial line 11 is inserted through opening 34 in sleeve 33 such that center conductor 13 is pressed into beveled end 43 of upper chuck 41 and outer conductor 14 is pressed into split ferrule 32. Sleeve 33 is threaded into the outer sleeve 27 to compress ferrule 32 about outer conductor 14 and lock the coaxial line with the upper body.

Strip line 12 is inserted into the U-shaped bracket defined by legs 66 and 67 such that tab 54 slidably engages center conductor 17. Clamping screws 64 are inserted through the holes in leg 66 and strip line 12, and are then threaded into the holes in leg 67 to clamp the strip line to the lower body. Locking screw 68 is threaded downward to press block 21 against tab 54, thereby clamping the tab to center conductor 17. Clamping of tab 54 to center conductor 17 is adequate for high frequency applications; however, a solder connection may be used for low frequency applications.

An impedance mismatch almost invariably results when connecting coaxial line 11 to strip line 12. Tuning screws 61 are adjustably positioned within cavity 49 to vary the capacitance of the cavity. Such varying of the capacitance of the cavity is commonly referred as "tuning." Since impedance is a function of capacitance, the impedance mismatch of the coaxial line and strip line is compensated by adjustment of the tuning screws.

Although two tuning screws 61 are shown opposite each other in the figures, it is to be understood that the tuning screws may be placed at positions other than

opposite and more than two may be employed. The number and positions of tuning screws **61** employed is dependent on the frequency of the transmitted signal, the strip line circuitry (represented by center conductor **22**), and the amount of capacitance needed to be compensated.

By varying the capacitance of cavity **49** to match the impedance of lines **11** and **12**, a phase shift is introduced into a signal being transmitted along the over-all line. The position of projection **30** of upper body assembly **26** is adjusted within lower body **24** to alter the axial length of cavity **49**. Since the phase shift experienced by the signal is also a function of the physical length of the conducting path, this alteration of the length of cavity **49** effectively changes the length of the conducting path and thereby compensates for the phase shift introduced by the impedance matching. It follows that the alteration of the length of cavity **49** also compensates for phase shift in a signal introduced by the coaxial line and strip line themselves. Lock nut **46** is adjusted to lock lower body assembly **24** and upper body assembly **26** in position.

Although the invention has been described and illustrated with respect to a straight connection between a coaxial line and a strip line, it will be apparent to one skilled in this art that the connector can be modified to connect a coaxial line and a strip line at other angles, for example 90°. This can be accomplished by modifying the external U-shaped bracket for clamping the strip line to the connector.

It is to be understood that the above-described embodiment is illustrative of the principles of the invention and many others could be devised without departing from the scope of the invention.

What is claimed is:

1. A coaxial line to strip line connector, comprising
a body including a conductive path between the lines and defining a cavity which comprises a portion of the path,
means for tuning the cavity to compensate for impedance mismatch of the lines, and
means for adjusting the cavity to compensate for the phase shift in a signal being transmitted along the lines.

2. A coaxial line to strip line connector, comprising
a body having facilities for securing the coaxial and strip lines thereto and providing a conductive path between the lines, the body defining a cavity which comprises a portion of the conductive path,
first adjustable means projecting into the cavity for tuning the cavity to compensate for impedance mismatch of the lines, and
second adjustable means for altering the length of the cavity to compensate for phase shift in a signal being transmitted along the lines.

3. A coaxial line to strip line connector, comprising
a body having facilities for securing the coaxial and strip lines to provide a conductive path between the lines,
a tuning cavity defined by the body and interposed in the conductive path between the coaxial and strip lines,
tuning elements adjustably positionable within the cavity for matching the impedance of the lines, and
means coupled to the body for altering the axial length of the cavity to compensate for any phase shift in a signal being transmitted along the lines.

4. A coaxial line to a strip line connector, comprising
a hollow lower body open on one end and having elements for securing a strip line thereto,
an upper body having facilities for securing a coaxial line thereto and connected to close the open end of the lower body to define a cavity, the lower and upper bodies providing a conductive path between the lines,

tuning elements projecting through the walls of the lower body into the cavity and adjustable in position for varying the capacitance of the cavity to match the impedance of the lines, and
means for adjusting the relative position of the upper and lower bodies to alter the length of the cavity to compensate for any phase shift in a signal being transmitted over the lines.

5. A connector for connecting a coaxial transmission line having a center conductor concentrically positioned within an outer conductor to a strip transmission line having a flat, center conductor sandwiched between a pair of flat outer conductors, comprising
a clamping section for clampingly engaging the outer conductors of the strip line,
a lower body terminating at the clamping section and defining an open-ended internal cavity,
an upper body having facilities for securing the outer conductor of the coaxial line thereto and connected to the lower body for closing and adjusting the axial length of the cavity,
means extending axially through the cavity and the upper and lower bodies for connecting the center conductor of the coaxial line to the center conductor of the strip line,
tuning elements extending through the walls of the lower body into the cavity and adjustable in position for matching the impedance of the coaxial line to that of the strip line, and
means for locking the upper body within the lower body after adjustment of the axial length of the cavity to compensate for any phase shift introduced into a signal being transmitted along the lines.

6. A connector for connecting a coaxial transmission line having a center conductor concentrically positioned within an outer conductor to a strip transmission line having a flat center conductor sandwiched between a pair of flat outer conductors, comprising
a lower body having an open-ended cavity on one end,
a pair of legs extending from the other end of the lower body for clamping the outer conductors of the strip line to the connector.
an upper body having an opening for receiving the coaxial line and threadably connected to the lower body for closing and adjusting the length of the cavity,
a sleeve through which the coaxial line extends and threadable into the opening for securing the outer conductor of the coaxial line to the upper body,
a chuck extending axially through the cavity and the upper and lower bodies for connecting the center conductor of the coaxial line to the center conductor of the strip line,
tuning elements extending through the walls of the lower body into the cavity and adjustable within the cavity for varying the capacitance of the cavity to match the impedance of the coaxial line to the strip line, and
a locking element for securing the upper body within the lower body after adjustment of the axial of the length of the cavity to compensate for the phase shift introduced into a signal being transmitted along the over-all line.

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HERMAN KARL SAALBACH, *Primary Examiner.*

Dedication

3,201,721.—*Rudolph W. Voelcker*, Greensboro, N.C. COAXIAL LINE TO STRIP LINE CONNECTOR. Patent dated Aug. 17, 1965. Dedication filed June 5, 1972, by the assignee, *Western Electric Company, Incorporated.*

Hereby dedicates to the Public the entire remaining term of said patent. [*Official Gazette January 2, 1973.*]