

Dec. 5, 1967

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3,356,983

TRANSMISSION LINE CABLE CONNECTOR

Filed Oct. 11, 1965

2 Sheets-Sheet 1

FIG. 1

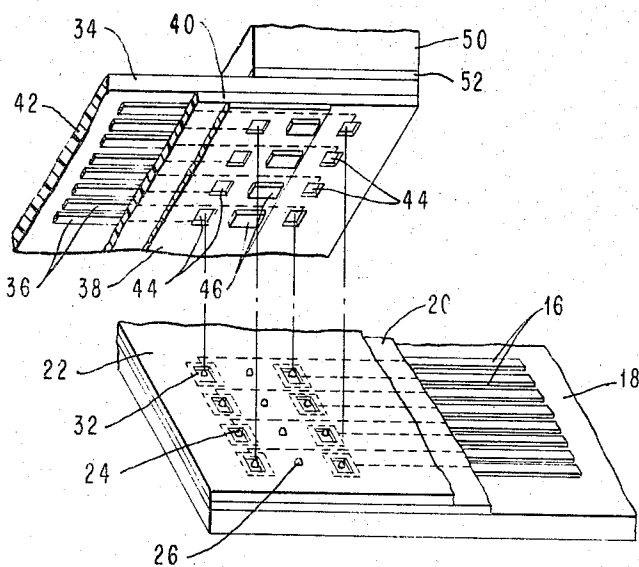
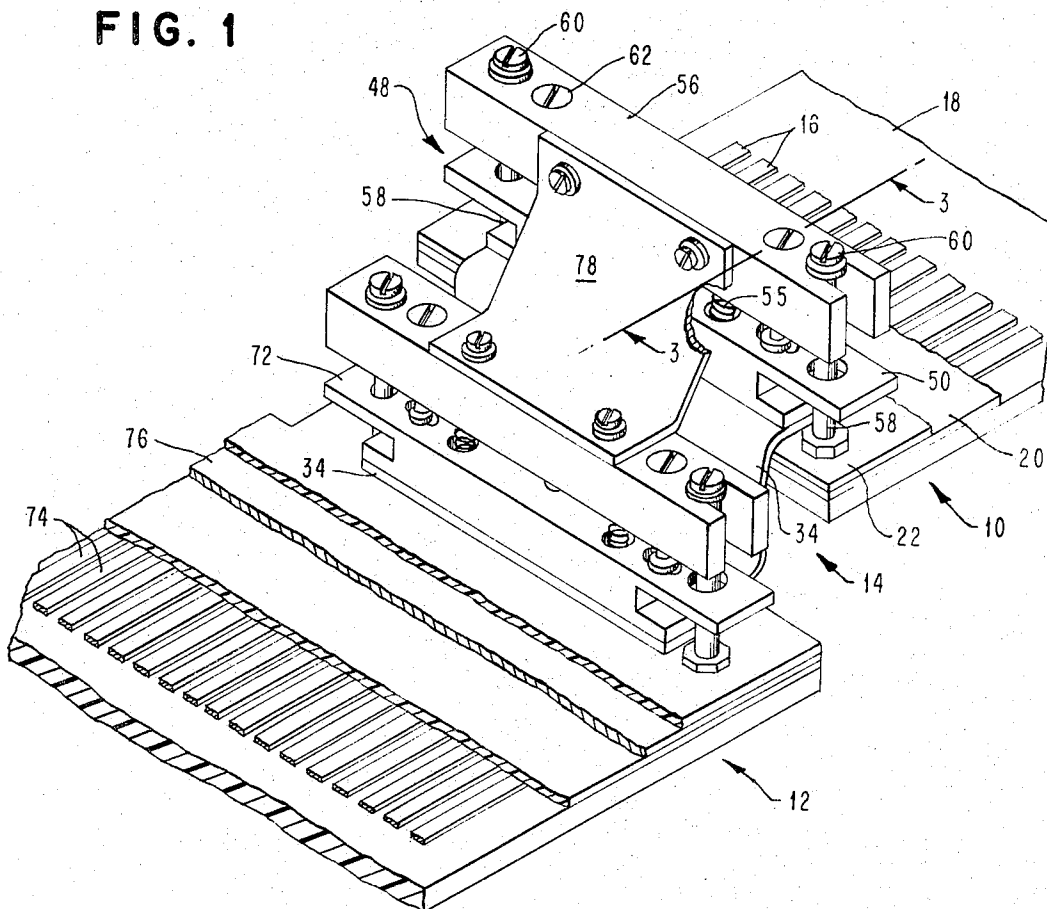


FIG. 2

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Dec. 5, 1967

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2 Sheets-Sheet 2

FIG. 3

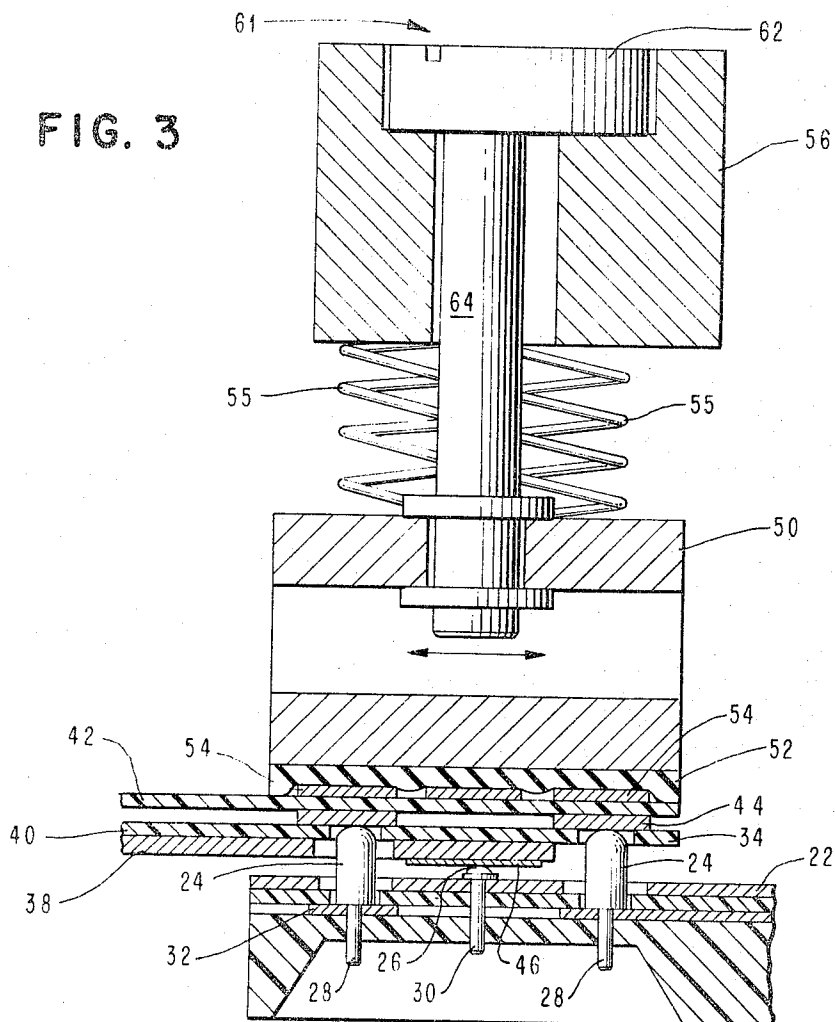
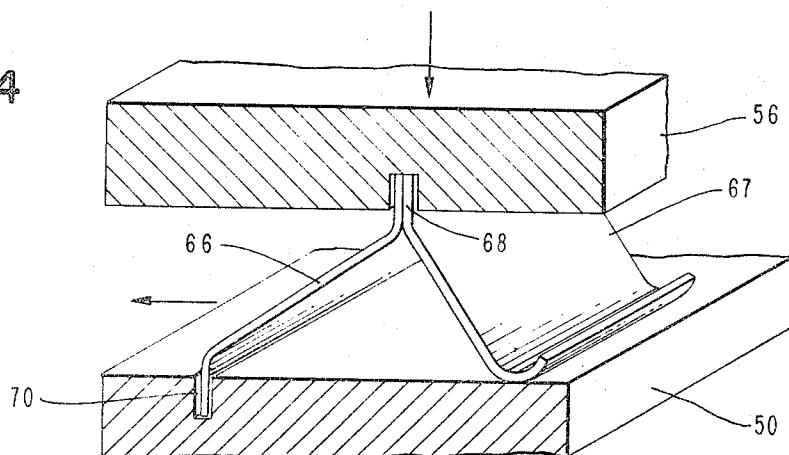


FIG. 4



1

3,356,983

TRANSMISSION LINE CABLE CONNECTOR

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Filed Oct. 11, 1965, Ser. No. 494,496

6 Claims. (Cl. 339-14)

ABSTRACT OF THE DISCLOSURE

This specification describes a connector for multiple conductor transmission line cables. The male portion of this connector is a rigid member with a number of short protuberances extending therefrom and the female portion of the connector is a rigid member with a like number of flat, individually deflectable and bendable contact areas thereon which are designed to be contacted by the protuberances. To make electrical connection between the male and female portions of the connectors, the protuberances of the male member are held against the individually deflectable contact areas of the female member by a yieldable force after being brought into engagement with the deflectable areas with a wiping contact.

Background of the invention

The present invention relates to flat, multiple conductor transmission line cables or striplines and more particularly to connectors for such cables or striplines.

Cables or striplines comprising a number of transmission line pairs arranged in or on a strip of nonconductive material are used quite extensively at the present time. However, there is no completely satisfactory means now available for making electrical connections to these cables. Presently available connection means either introduce impedance mismatches into the transmission line pairs of the cable, or they do not provide proper electrical and/or mechanical connections to the cable.

Therefore, it is an object of the present invention to provide new connection means.

A further object of this invention is to provide connection means for multiple conductor transmission line cables.

Another object of this invention is to provide a connection means for multiple conductor transmission line cables which does not introduce a significant impedance mismatch.

Summary

In accordance with the present invention, the foregoing objects are realized with a new connector. The male portion of this connector is a rigid member with a number of short protuberances extending therefrom, and the female portion of the connector is a rigid member with a like number of flat, individually deflectable contact areas thereon which are designed to be contacted by the protuberances. To make electrical connections between the male and female portions of the connectors, the protuberances of the male member are held against the individually deflectable areas of the female member by a yieldable force after being brought into engagement with the deflectable areas with a wiping contact. The use of the short protuberances in conjunction with the flat, individually deflectable contact areas allows the reduction of the inductive impedance introduced by the connector and thereby minimizes any impedance mismatch caused by the connector. Furthermore, when the protuberances and contact areas are brought and held together in the manner described above, good electrical and mechanical connections are effected between the two portions of the connector.

2

Description of drawings

The foregoing and other objects and features and advantages of the invention will be apparent from the following more particular description of two preferred embodiments of the invention as illustrated in the accompanying drawings of which:

FIG. 1 is a three-dimensional representation of one embodiment of the present invention.

FIG. 2 is a three-dimensional view of the contacts in FIG. 1.

FIG. 3 is a sectional view taken along line 3-3 in FIG. 1.

FIG. 4 illustrates an alternative means for applying the contact and wiping forces.

Description of preferred embodiment

Referring to FIG. 1, a rigid, flat multiple transmission line cable 10 is electrically and mechanically connected to a printed circuit board 12 by connection means 14 incorporating the present invention. The transmission line cable 10 has a number of conductors 16 positioned on a rigid nonconductive plastic support 18. Covering the conductors 16 is a layer of flexible plastic 20 such as Mylar, and over the plastic layer there is a thin metal ground plane 22. Each conductor 16 forms a transmission line pair with the ground plane 22. The characteristic impedance of these transmission line pairs is determined by the width of the conductors and the spacing between the conductors 16 and the ground plane 22 and by the dielectric characteristics of the Mylar layer 20.

As shown in FIGS. 2 and 3, the conductors 16 are terminated in short protuberances 24 which extend upwardly from the top surface of the transmission line cable 10. Likewise, the ground plane 22 is terminated in a number of short protuberances 26 extending upwardly therefrom. The protuberances 24 and 26 are the heads of gold pins 28 and 30 which pass through the support of the rigid transmission line cable 10. The pins 28 are electrically and mechanically connected to end areas 32 of the conductors 16 by soldering, and extend through rectangular apertures in the plastic layer 20 and the ground plane 22 so that electrical connections can be individually made to the conductors 16 from the top of the transmission line cable 10 by contacting the protuberances 24. The pins 30 are electrically connected to the ground plane 22 by soldering so that the electrical connections can be made to the ground plane from the top of the transmission line cable 10 by contacting protuberances 26.

Overlapping the end of the transmission line cable 10 is a second, flexible transmission line cable 34. This second cable 34, like the rigid transmission line cable 10, has a number of conductors 36 and a flexible metal ground plane 38 spaced from each other by a flexible plastic layer 40 so as to form a number of transmission line pairs each consisting of the ground plane 38 and one of the conductors 36. The conductors 36, the ground plane 38 and the flexible plastic layer are mounted on a flexible nonconducting plastic layer 42 for support.

At the overlapping end of the second flexible transmission line cable 34, there are a number of gold plated, flat rectangular contact areas 44 and 46. The flat contact areas 44 are electrically connected to the ends of the conductors 36, and are exposed through rectangular apertures in the ground plane 38 and the Mylar layer 40 so that they may be contacted by the protuberances 24 to make electrical connections between the conductors 16 and 36. The other flat contact areas 46 are electrically and mechanically fixed by soldering to the ground plane 38 where they may be contacted by the protuberances 26 to make electrical connections between the ground planes 22 and 38.

To hold the flat contact areas 44 and 46 against the protrusions 24 and 26, a connector member 48 is provided. Part of this connector member is a rigid pressure exerting member 50. The end of the flexible transmission line cable having the contact areas 44 and 46 thereon is fixed to the rigid pressure exerting member 50 by a rubber layer 52 which is bonded by a suitable adhesive to the member 50 and the support layer 42. Between the rubber layer 52 and the support layer 42 there are little brass support pads 54 which are positioned behind each of the contact areas 44 and 46 to give the proper amount of rigidity to each of the contact areas.

A rigid clamping member 56 exerts force on the pressure exerting member 50 through three coil springs 55 positioned in a row between the two members 50 and 56. The clamping member 56 is secured to the rigid transmission line cable 10 by means of two rods 58 positioned at opposite ends of the member 56. The rods 58 are fixed to the rigid transmission line cable 10 and extend upwardly from its top surface through apertures at the ends of the members 50 and 56. The top ends of the rods 58 are axially threaded to receive screws 60. The heads of these screws 60 bear against the top surface of member 56 to exert the securing force when the screws are tightened into the threaded ends of the rods 58.

With the clamping member 56 secured to the rigid transmission line cable 10 as described above, the springs 55 are compressed between the members 50 and 56 and exert a force with member 50 to hold the end of the flexible transmission line cable 34 against the end of the rigid transmission line cable 10. With the ends of the flexible and rigid transmission line cables held against one another, the protuberances 24 pass up through the rectangular apertures in the ground plane 38 and the flexible plastic layer 40 to contact the contact areas 44 and thus electrically connect each of the conductors 16 in the rigid transmission line cable 10 to its corresponding conductor 36 in the flexible transmission line cable. Likewise, each of the protuberances 26 engages the contact areas 46 to make a number of electrical connections between the ground plane 22 of the rigid transmission line cable 10 and the ground plane 38 of the flexible transmission line cable 34. Because of the rubber layer 52, each of the contact areas 44 and 46 is individually deflectable under the pressure exerted on it by the particular one of the protuberances which engages it. Therefore, the areas 44 and 46 can deflect more or less to allow for small differences in the heights of the protuberances 24 and 26. The individual brass back pads 54 prevent excessive dimpling of the soft copper contact areas while permitting a sufficient amount of contact force to each of the connections.

After the contact is made, the contacting surfaces of the protuberances 24 and 26 and the contact areas 44 and 46 are caused to wipe against each other by camming means which comprise two eccentric bolts 61 mounted in holes in the two members 50 and 56. The heads 62 of the bolts are set in the top of member 50 and are eccentrically mounted on the shaft 64 of the bolts which pass through openings in both the members 50 and 56. When the heads 62 are rotated, they cause the shafts 64 to move in a path which causes them to contact the sidewalls of the oblong holes through which they pass in the member 50. The force exerted by this contact makes the member 50 move relative to the member 52 and the rigid transmission line 10 in the directions of the arrows in FIG. 3 as a result of the orientation of the oblong holes. In moving, the member 50 causes the flat contact areas 44 and 46 to rub against the protrusions 24 and 26 in a wiping movement that cleans the contacting surfaces of the contact areas and protrusions so that there is good electrical contact between them. The rods 58 do not interfere with the movement of member 50, because they pass through oversize holes in the member 50 which allow the member 50 to move freely of the rods 58 in the directions of the arrows.

A substitute for the coil springs and the camming means are the leaf springs 66 and 67 shown in FIG. 4. These springs 66 and 67 extend along the lengths of the members 50 and 56. Opposite edges of spring 66 are positioned in slots 68 and 70 in members 56 and 50 respectively, while one edge of spring 67 is positioned in slot 68 and the other edge of spring 67 is curved to slide on the top surface of member 50. When the screws 60 are tightened into the rods 58, these springs 66 and 67 will bend to exert the contact force and simultaneously cause member 50 to slide in the direction of the horizontal arrow in FIG. 4 to exert the wiping force.

The connection of one end of the flexible transmission line cable 34 to the rigid transmission line cable 10 has now been discussed in detail. The other end of the flexible transmission line cable 34 is electrically and mechanically connected to the printed circuit board 12 with a second connection member 72 in the same manner. Contact areas on the flexible transmission line cable 34 are held against protrusions extending from the printed circuit 12 to electrically connect the conductors 36 of the flexible transmission line cable to corresponding electrical conductors 74 in the printed circuit board and to electrically connect the ground plane 38 of the flexible transmission line cable to a metal ground plane 76 in the printed circuit board. Therefore, a discussion of the connection between the flexible transmission line cable 34 and the printed circuit board 12 would be repetitious and is omitted.

The two connection members 48 and 72 are joined together by a rigid bracket 78. This is to simplify the mechanical connection of the connection members 48 and 72 to the rigid transmission line cable 10 and the printed circuit board 12. Once the connections have been made, the bracket 78 is removed to provide a flexible electrical connection between the rigid transmission line cable and the printed circuit board.

The above-described connector 14 provides an electrical connection between the terminals on stripline 10 and the terminals on printed circuit board 12 without introducing any significant impedance mismatches. This is because protuberances on the stripline 10 and on the board 12 are quite short and the connections for each conductor 16 and 74 are positioned close to a connection to the ground plane to minimize the inductive impedance introduced by the connector. Furthermore, the transmission line characteristics of the flexible stripline 34 are matched to the transmission line characteristics of the stripline 10 and the printed circuit board 12 so that the stripline 34 does not introduce any mismatch. If there was a mismatch between the stripline 10 and the printed circuit board 12, the transmission line characteristics of the stripline 34 could be adapted to correct this mismatch.

The electrical connection provided by the connector 14 is a low resistance high-density connection. The low resistance connections are due in part to the fact that the flat contact areas are individually deflectable under the resilient force exerted on them by the protuberances to assure that the proper contact force is exerted at each connection. In addition, the wiping contact supplied by the camming of the connector members with respect to one another assures that the contacting surfaces are clean.

While the invention has been shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

I claim:

1. An electrical stripline connector comprising: first, second and third members which are substantially rigid, said first and second members having facing portions;

5

spring means joining the second and third members together in a resilient connection;

means for coupling the first and third members together to force the facing portions of the first and second members together with said spring means;

first stripline means attached at one end to one of said facing portions, said first stripline means having, in layers, a ground plane, a series of stripline signal conductors, and an intermediate nonconducting layer;

second stripline means attached at one end to the other of said facing portions so that end portions of the first and second stripline means overlap and are held together, said second stripline means having in layers a ground plane, a series of stripline signal conductors and an intermediate nonconducting layer;

electrically conductive protuberances extending from the conductors and the ground plane of the first stripline means in the overlapped end portion of said first stripline means; and

substantially flat electrically conductive contact areas attached to each of the conductors and the ground plane of the second stripline means in the overlapped end portion of said first stripline means, said contact areas each being abutted against one of said protuberances to make an electrical connection between the first and second stripline means.

2. The electrical stripline connector of claim 1 including a resilient layer between the contact areas and the member to which the second stripline is attached to permit the contact areas to deflect individually of one another under the force exerted on them by the connector elements.

3. The electrical stripline connector of claim 1 including cam means coupled between said second and third members for moving said second member relative to said first member at right angles to the contact force exerted by the spring means to cause a wiping action between each protuberance and contact area combination.

4. The electrical stripline connector of claim 1 wherein each protuberance extending from one of the signal conductors of the first stripline is positioned adjacent to a protuberance extending from the ground plane of the first stripline and each contact area attached to one of the signal conductors in the second stripline is positioned adjacent a contact area attached to the ground plane of the second stripline whereby impedances mismatches caused by the connector are reduced in magnitude.

5. A connector for coupling two multiple conductor cables together comprising:

first and second connector means;

a flexible stripline which forms a number of electrical connections between the first and second connector means;

6

means for mechanically and electrically connecting the first connector means to one of the two multiple conductor cables;

means for mechanically and electrically connecting the second connector means to the other of the two multiple-conductor cables so that electrical connections are made between the two cables through the first and second connector means and the flexible stripline; and

removable bracket means for holding the first and second connector means together until they are mechanically and electrically attached to the multiple conductor cables.

6. An electrical connector comprising:

first and second members which are substantially rigid and have facing portions;

a third member;

coil springs connected at one end to the second member and at the other end to the third member;

clamping means for coupling the third member to the first member so that the second member is held against the first member by the coil springs;

protrusions extending from one of the mentioned facing portions;

substantially flat contact areas on the other of the mentioned facing portions, each of said contact areas being held against one of the protrusions by the force of the coil springs to form an electrical connection between the first and second members, said contact areas being individually deflectable under the force exerted by the protrusions to develop the necessary contact pressure between each of the protrusions and flat contact areas; and

cam means for moving said first and second members relative to each other at a right angle to the contact force exerted by the coil springs to cause a wiping action between each of the protrusions and flat contact areas, said cam means including an eccentric shaft means which is rotatably mounted in each of the second and third members so that as the eccentric shaft means is rotated it causes the mentioned relative movement.

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