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[54] CONNECTOR WITH LOAD SHARING CONTACTS 7 Claims, 10 Drawing Figs.

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 339/176

[51] Int. Cl..... H01r 13/62

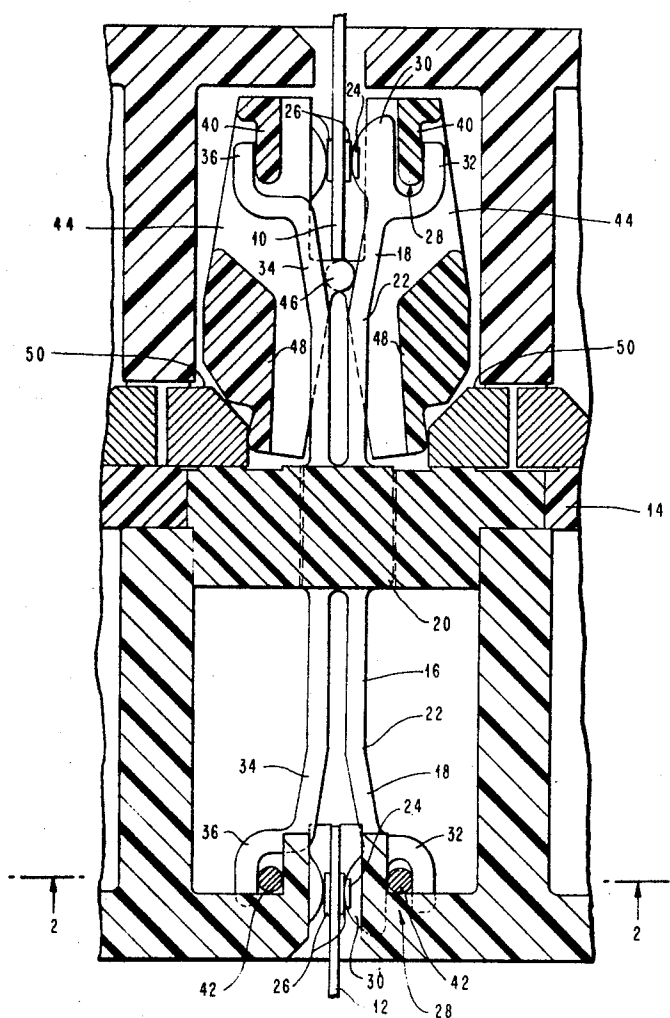
[50] Field of Search..... 339/17, 74,
 75, 176

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ABSTRACT: This specification describes a connector which has a plurality of flexible U-shaped elements each with one arm of the U forming a contact carrying member for making electrical connections to lands on circuit boards inserted into the U and the other arm of the U forming a helper member for aiding in exerting the contact force on the lands. The position of the contact carrying members and the helper members is alternated from one side of the circuit board to the other so that the contacts engage lands on both sides of the circuit board. On each side of the circuit board, the members are positioned against the board while the helper members are spaced away from the board so that helper members and contact members form channels between them on both sides of the board. These channels each contain a floating force member which transfers a portion of the force exerted on the contact carrying members by the lands to the helper members.



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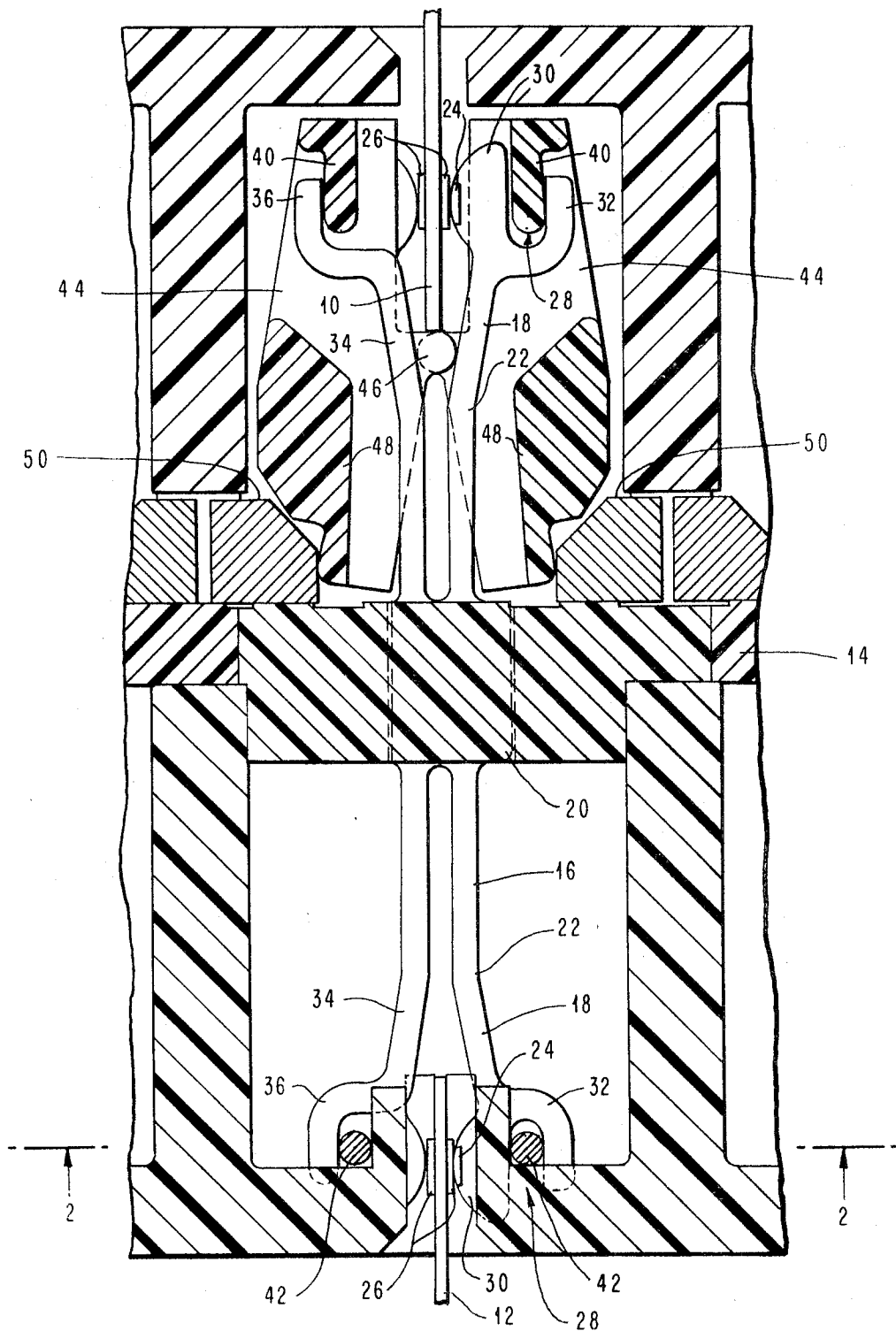


FIG. 1

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FIG. 2

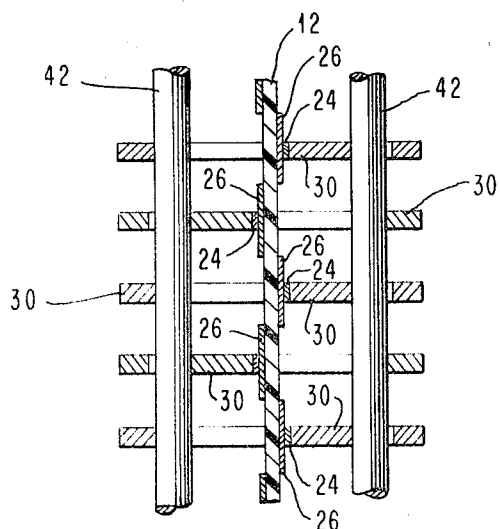


FIG. 3A

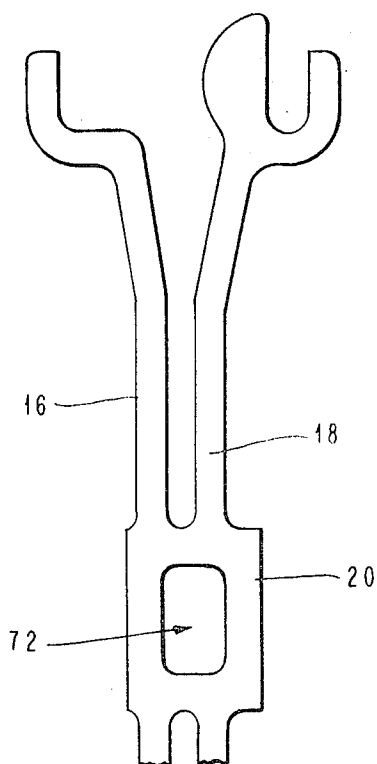


FIG. 3B

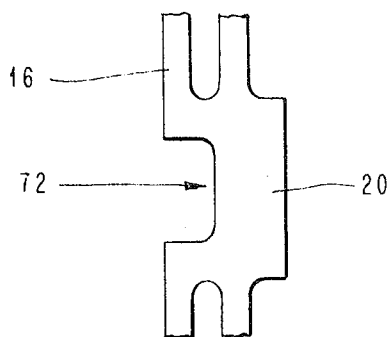


FIG. 3D

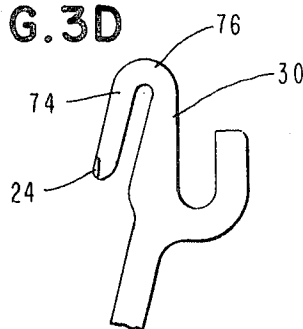


FIG. 3C

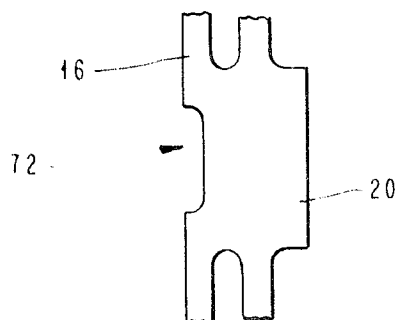


FIG. 3E

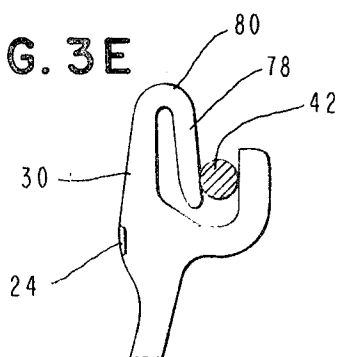


FIG. 4

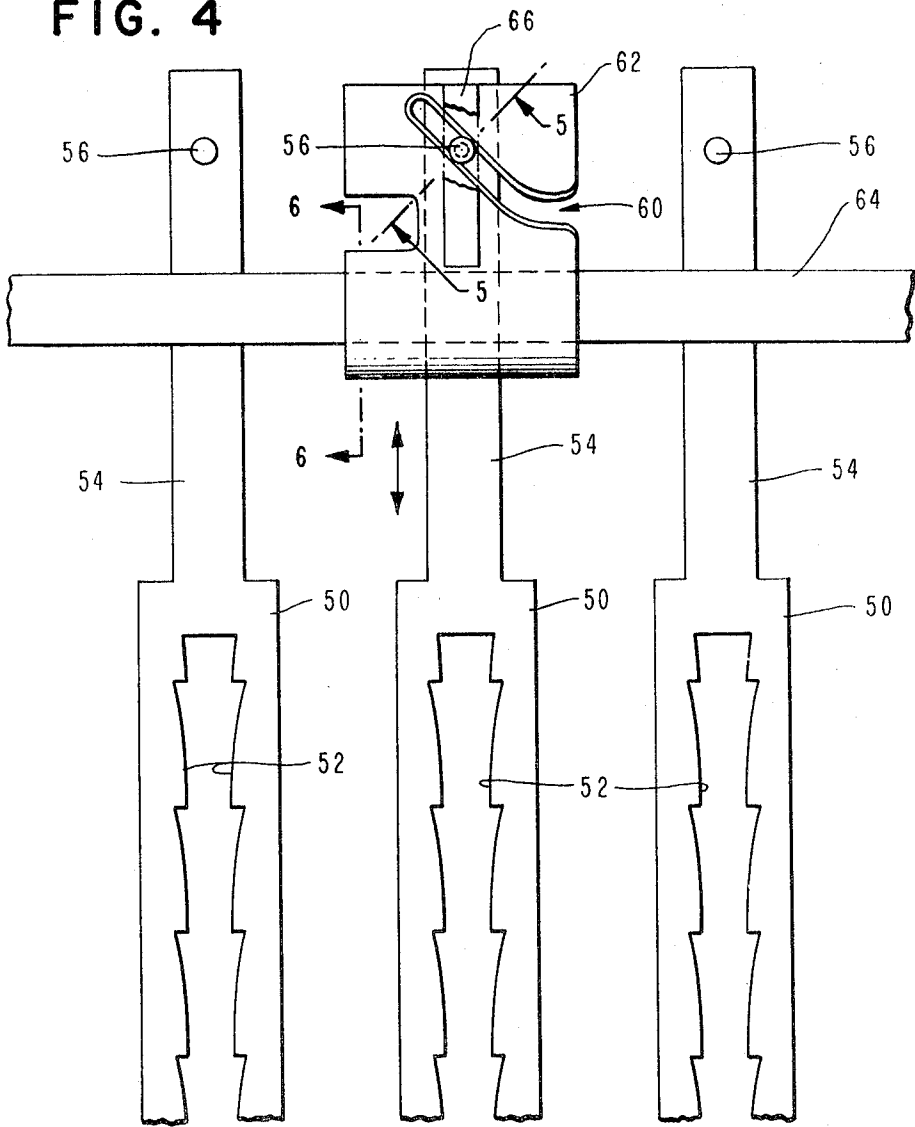


FIG. 5

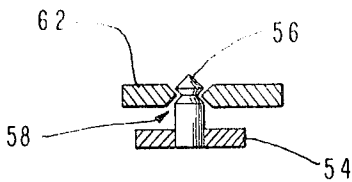
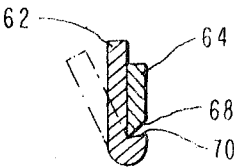


FIG. 6



CONNECTOR WITH LOAD SHARING CONTACTS

BACKGROUND OF THE INVENTION

This invention relates to connectors and more particularly to connectors for making electrical contacts to circuit boards or cards.

As printed circuit technology has progressed, the number of electrical connections that have to be made in a given area of a circuit board or card has increased. This results in a reduction in the spacing between the contacts for making these connections to the circuit board. As the spacing is decreased, it becomes more difficult to make electrical connections and still maintain desirable mechanical and electrical characteristics for the connector containing the contacts. For example, under very critical contact spacing conditions slight variations in the thickness of the circuit boards or position of the electrical contacts in the connector can cause a contact to contact variation in contact force. This will cause one connection to be open due to the lack of sufficient contact force and another to wear or gouge the contact lands on the circuit board because of excessive contact force. Another consequence of decreasing the interconnect spacing is that electrical crosstalk and arcing are more likely to occur between adjacent contacts.

SUMMARY OF THE INVENTION

In accordance with the present invention contact members can be placed on very close centers while at the same time obtaining high contact pressure and assuring the electrical integrity of adjacent contacts. This is accomplished by using flexible U-shaped contact elements each with one of the arms of the U forming a contact carrying member for making contact with lands mounted on the circuit board inserted into the U and the other of the arms of the U forming a helping member for aiding in exerting the contact force on the lands. The position of the contact members is alternated with respect to the circuit board so that the contacts engage lands on both sides of the circuit board. On each side of the circuit board the contact members are positioned against the board while the helper members are spaced away from the board so that the contact members and helping members on any one side of the circuit board form a channel between them on both sides of the board.

A floating force member is positioned on each of these channels. The floating force members are free to move in the channel relative to both the contact carrying and helping members to transfer a portion of the force exerted on the contact carrying members by the lands on the circuit board to the helping members whereby the helping and contact members share the contact load. In this way the contact members can be made thinner and placed on closer centers since the helping members form an additional set of force bearing members positioned behind the contacts leaving the extra room along the contact line. With the use of this thinner contact the electrical integrity of the adjacent contact member is increased since larger spaces can be placed between the contacts and still maintain the same connection density. Furthermore, variations in board thickness and contact orientation or position are compensated for since the floating force members through their load sharing characteristics tend to redistribute any inequalities in contact force.

Therefore it is an object of the present invention to provide a connector which compensates for variations in contact force from connector to connector.

Another object of the invention is to provide a connector having contacts that can be used with small contact to contact spacings.

Another object of this invention is to provide a connector with contact that may be altered to adjust its characteristic impedance to fit the application for the connector.

Another object of the invention is to provide a zero insertion force connector.

Another object is to provide a zero insertion force connector having contacts with a wiping action.

DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a section through a connector fabricated in accordance with the present invention;

FIG. 2 is a section taken along lines 2-2 in FIG. 1;

FIG. 3a, b and c are plan views of U-shaped elements with alternative configurations that can be used to vary the characteristic impedance of the connector;

FIGS. 3d and e are plan views of alternative contact member configurations which provide a connection with improved wiping action and contact force distribution, respectively.

FIG. 4 is a plan view of a mechanism for opening and closing contacts of connectors fabricated in accordance with the present invention;

FIG. 5 is a section taken along line 5-5 in FIG. 4; and

FIG. 6 is a section taken along line 6-6 in FIG. 4.

DESCRIPTION OF EMBODIMENTS

The embodiment of the invention shown in FIG. 1 is an interface connector for making connections between a card 10 immersed in liquid and a card 12 open to the atmosphere. A barrier wall 14 separates the liquid from the atmosphere. Conductors 16 of the connector pass through a barrier wall to provide an electrical path from the board 10 to the board 12. These conductors each consist of two U- or V-shaped elements 18 joined by a body portion 20.

One arm 22 of each U-shaped element 18 is a contact carrying member and it carries at its tip a contact 24 which engages a conductive land 26 on the cards 10 or 12. Each such tip has a slot 28 in it. On one side of the slot is a contact carrying head 30 and the other side is an arm 32. The purpose of the slot defined by the arm 32 and the head 30 shall be discussed in detail later in this specification. The other arm of each U-shaped member is a force bearing member 34. This force bearing member 34 is shaped like a contact bearing member 22 with contact bearing head 30 missing. However it does have an arm 36 closely resembling the arm 32 of the contact bearing member 22.

In a connector fabricated in accordance with the present invention there are a number of U-shaped elements of the configuration just described. The arrangement of these elements is best illustrated in FIG. 2 where the board 12 is shown having conductive pads 26 on both sides. These pads 26 are each contacted by contact 24 mounted on the head 30. Thus it can be seen that the contact member 22 varies from side to side of the board 12. At one time the contact member 22 is on the right-hand side of the board. In the next position the contact member 22 is on the left-hand side of the board.

In arranging these contact members 22 in this manner a channel is defined on both sides of the board 12 by the slots 28 in the contact carrying arm 22 and by the arm 36 on the load sharing member 34. A force bearing member rests in both these channels. As shown in FIG. 1, this force bearing member is a flange 40 forming a portion of a zero insertion force actuation mechanism on the liquid side of the wall and a rod 42 for the section of the connector open to the air.

Referring back to FIG. 2, it can be seen that with the card 12 inserted into the connector, the contact force exerted by the lands 26 on the contacts 24 is transferred by the head 30 to the rods 42 forcing the rods 42 against the arms 36 of the load bearing members. The contact arms 22 and the load bearing arms 34 are flexible. Thus a portion of the contact force is transferred from the contact member 22 to the load bearing member 34. In fact one-half the force is so transferred with the arrangement of FIG. 2.

Since the contact force is distributed equally among the contact members 22 and the load bearing members 34, the U-shaped elements can be made quite thin permitting the contacts to be placed close together while obtaining a high contact force. Furthermore, the contacts can be placed closer together without fear of destroying the electrical integrity of any one contact. In addition, a chemical milling may be employed to manufacture these members since they are thinner than the normal contact members. By chemical milling costs are reduced. Also the locked-in stresses which occur when parts are stamped are eliminated and the parts may be processed, heat treated in sheet form prior to milling. However the most important advantage of the configuration is that variation in the thickness of the board 12 or variations in the position and orientation of the contacts 24 are compensated on by the load sharing characteristics of the floating force members.

As mentioned previously the card 10 and the connector for it are in a liquid cooling medium. In such a medium it is necessary that zero insertion force connection be used. For this purpose the load bearing members are in the form of flanges 40 on two clam shell-shaped lever members 44 which pivot around pivot points 46. The pivot points 46 are located at each end of the row contacts 24 and the flanges 44 extend between them. Also extending between the pivot points 46 are camming sections 48. These camming sections 48 bear against cams 50 which cause the lever members 44 to pivot about point 46 thereby changing the relative positions of the flanges 40. In one position the flanges 40 allow the contacts to bear against the lands 26 located on printed circuit card 12. In another position the flanges 40 press against the arms 32 pulling the contacts 24 back away from their contact position thus allowing the card 12 to be inserted or extracted from the connector without contacting the contacts 24 thereby providing a zero insertion force action for this connector.

As shown in FIG. 4 the camming members 50 are rectangular with the irregular camming surface 52 located in their interior. This surface 52 is the surface that bears against the camming sections 48 of the clam shell lever members 44 to vary the force exerted on the arms and thereby cause the lever member 44 to move the contacts 24 between the zero insertion force position and the position in which the card 12 is electrically connected to the contacts 24.

Each of the cam members 50 has an arm 54 extending therefrom. At the end of this arm 54 is a knob 56 with a groove 58 therein. This groove 58 rides in guide groove 60 of an actuation member 62. The actuation member 62 travels along a rail 64 and engages the knob 56 in the guide groove 60. When the actuation member 62 is moved further the knob 56 rides up the groove 60 and in so doing causes the cam member 50 to move in the direction of the arrows. This causes the camming surface 52 to engage the contact member in the open contact position thus allowing the card 12 to be inserted into the connector without any difficulty. After the card 12 has been inserted the actuation member 62 is moved in the opposite direction causing the cam member 50 to move back to its initial position where the contacts 24 are closed on the circuit board 12.

The actuation member 62 contains an upstanding member 66 which is grasped to cause a movement along the guide bar 64. The actuation member 62 and the rail 64 have canted edges 68 and 70 which enables the actuation member to be pivoted on the rail 64 to avoid the knobs 56 of unselected cam members 50 in the movement of the actuation member 62 from position to position.

As mentioned previously the configuration of the conductor 16 can be changed to vary the characteristic impedance of the connection through the connector. In this way contact members can be altered to match the transmission line characteristics of the conductors on the cards 10 and 12. Referring to FIG. 3a, the body portion 20 of the conductor 16 contains an aperture 72. The capacitive coupling between this conductor and the two adjacent connectors depends on the size and posi-

tion of this aperture 72. As shown in FIGS. 3b and 3c the position and size of the aperture 72 can be changed and a large variation in the mentioned capacitive coupling can be accomplished by these changes. If every other conductor 16 is grounded, this means that the intermediate conductor 16 then can be selected with a selected impedance coupling it to ground. Thus the characteristic impedance of the intermediate conductor can be changed by changing the size and position of the aperture 72. Other ways of changing the characteristic impedance of a conductor would be to change the position and orientation of the contact carry member 22 and the helper members 34. These members 22 and 34 can be skewed relative to such members or adjacent conductors to vary the capacitive coupling adjacent conductors and thereby change the characteristic impedance of a conductor.

As shown in FIG. 1, the contact 24 is mounted on a curved portion of the head 30. However, in a zero insertion force connector, such as the liquid immersed one for card 10, it is desirable to obtain good wiping action. To increase wiping action the configuration shown in FIG. 3d can be employed. Here the contact 24 is mounted on a flexible arm 74 which when contact is made with the card 10 it pivots about point 76 causing the contact 24 to move along the plane of the card 10 and thereby obtain the wiping action. Where no liquid is being used a preferable form for the head 30 is shown in FIG. 3e. Here an arm 78 bends around point 80 and makes contact with the rod 42. This way variations in loading caused by variations in thickness of the card 12 or by differences in the position and orientation of the contacts 24 can be compensated for by the flexing of the member 78 around 80.

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

What I claim is:

1. A connector comprising:

a plurality of flexible U-shaped elements each with one arm of the U forming a contact carrying member for making electrical contact to lands on a circuit board inserted into the U and the other arm of the U forming a helper member, said contact carry members and said helper members being arranged on both sides of the circuit board so that the helper members and said contact carrying members on the same side of the board form a channel between them with contact carrying members positioned adjacent the board and helper members positioned on the other side of the channel; and

a force exerting member inserted in said channel, in physical contact with both contact carrying and helper members and mechanically floating with respect to both the contact carrying and helper members so that a portion of the force exerted on the contact carrying members by the lands is passed on by the force exerting members to the helper members whereby the helper and contact members share the contact force load.

2. The connector of claim 1 including:

a flexible arm with the contact thereon mounted on the arm carrying members for the obtaining of a wiping action when the contacts are closed upon the circuit board.

3. The connector of claim 1 including:

a flexible arm mounted on the arm carry members for engagement with the force exerting member to compensate for contact to contact differences in contact force.

4. The connector of claim 1 including:

means for varying the shape of said U-shaped elements to change the capacitance between adjacent U shaped elements and thereby change the transmission line characteristics of the elements.

5. The connector of claim 1 wherein there is a force exerting member in a channel on each side of the circuit board.

6. The connector of claim 5 including:

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zero insertion force means for moving said force exerting members normally with respect to the faces of the circuit board to change the spacing of the contacts.

7. The connector of claim 6 wherein the zero insertion force means includes:

lever arm means coupled to each of the force exerting mem-

bers; and

cam means for exerting a force on the lever arms means to cause the lever arm means to pivot and move the force exerting members.

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