

[54] CONTROL WIPE ELECTRICAL CONNECTOR FOR CIRCUIT CARDS

[75] Inventor: Mario Enrique Ecker, Poughkeepsie, N.Y.

[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

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[21] Appl. No.: 169,663

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Primary Examiner—Marvin A. Champion  
 Assistant Examiner—Lawrence J. Staab  
 Attorney—J. Jancin, Jr. et al.

[52] U.S. Cl. .... 339/176 MP, 339/17 L, 339/75 MP

[51] Int. Cl. .... H05k 1/07

[58] Field of Search ..... 339/59 M, 61 M, 74, 339/75 M, 75 MP, 176 MP, 174, 176 LC, 176 LM, 184 M, 186 M, 46

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[57] **ABSTRACT**

An electrical connector is provided which prevents damage to the edge of the card by the contact points during initial insertion but allows for wiping the circuit card at the contact terminal areas. The connector operates with two basic components, a resilient U-shaped element containing points for electrically contacting the circuit card and a rigid-conformal housing which controls the point of insertion at which electrical contact will take place as well as acts to hold the circuit card tightly in place after insertion.

10 Claims, 7 Drawing Figures

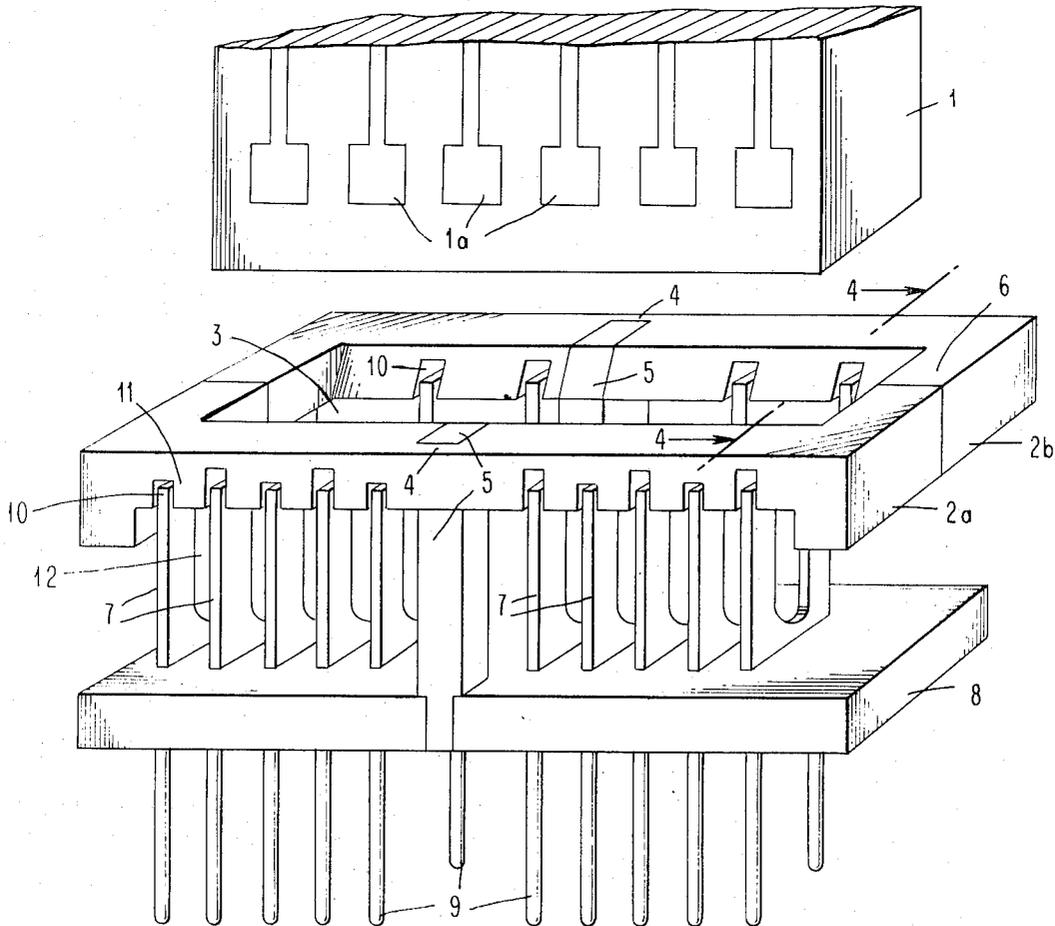


FIG. 1

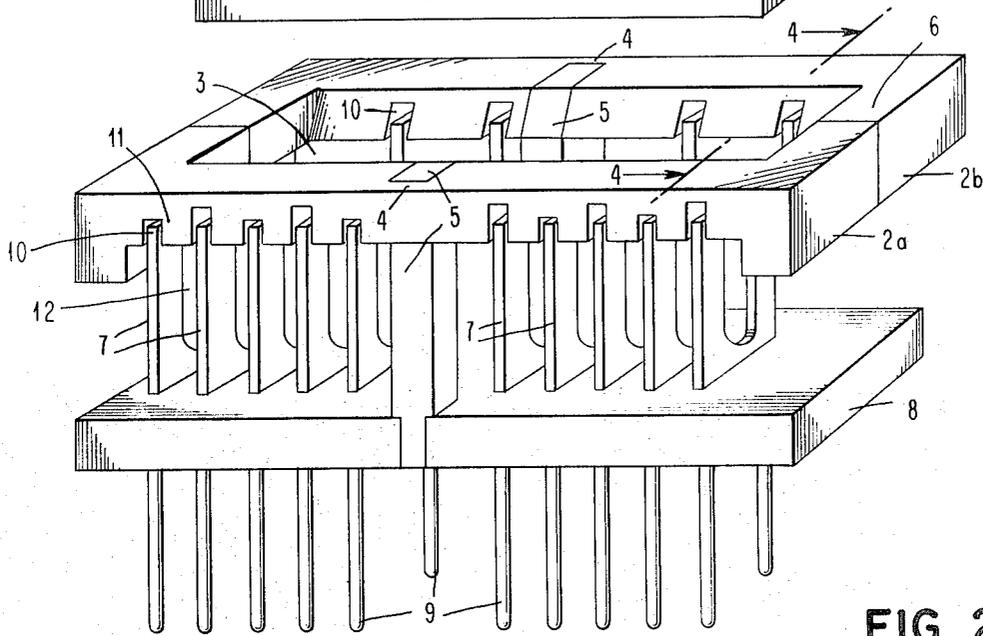
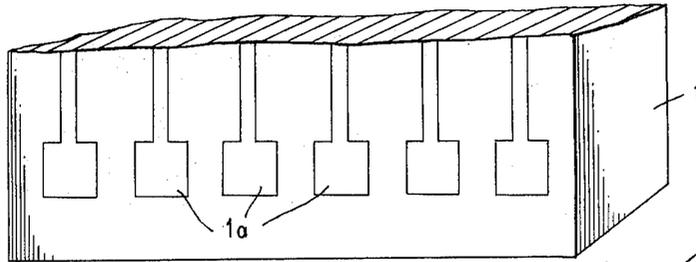


FIG. 2

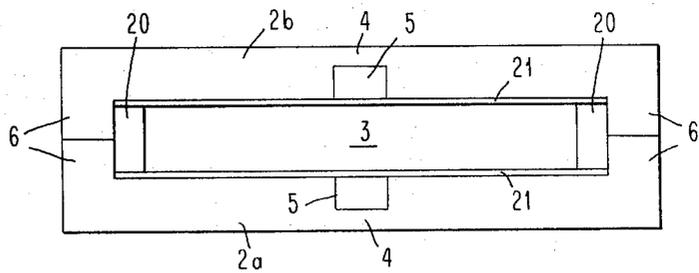
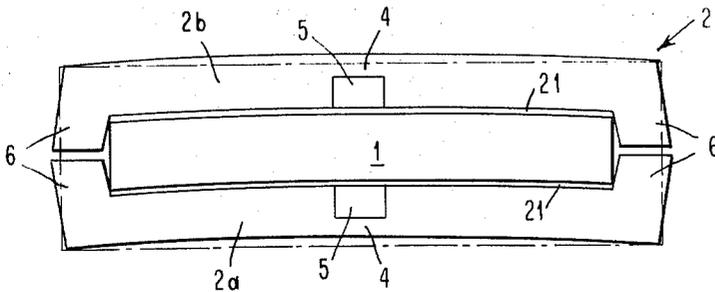


FIG. 3



INVENTOR  
MARIO E. ECKER

BY *Maurice H. Kitzman*

ATTORNEY

FIG. 4a

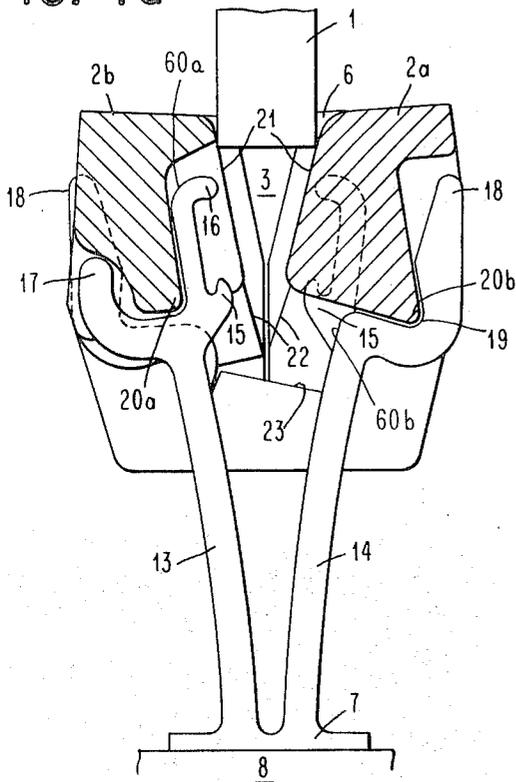


FIG. 4b

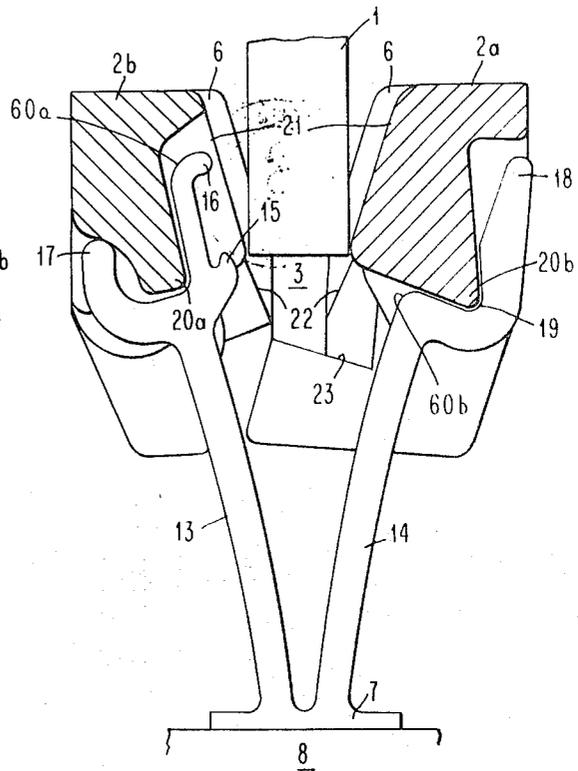


FIG. 4c

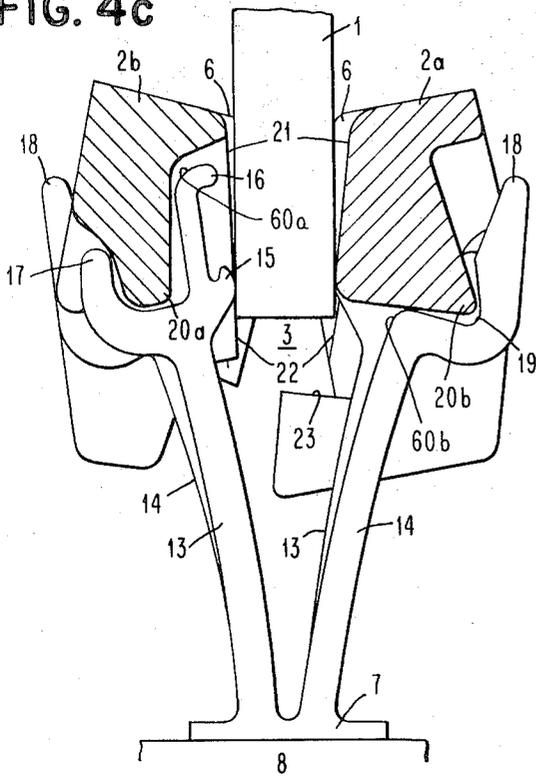
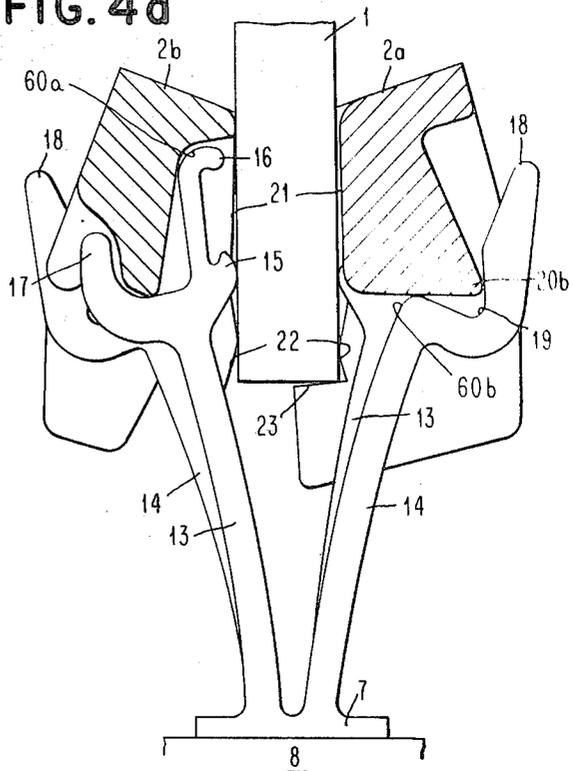


FIG. 4d



# CONTROL WIPE ELECTRICAL CONNECTOR FOR CIRCUIT CARDS

## BACKGROUND OF THE INVENTION

### 1. Field of Invention

The invention relates generally to electrical connectors and more particularly, to an electrical connector in which insertion of the circuit card moves the connector housing sections, the position of which control the point of insertion at which engagement of the connector contacts with the circuit card contact terminals is effected.

### 2. Prior Art

Conventional electrical connectors utilized for contacting circuit cards generally contain a multiplicity of strongly resilient contact elements which are forced apart by the circuit during initial insertion and which frictionally impinge, with a strong resilient force to ensure electrical contact, on the circuit card throughout the insertion distance. Thus, a large insertion force is required to overcome the frictional impingement throughout the insertion distance. Furthermore, because of the delicate nature of many circuit cards containing densely packed circuitry which must be fabricated using thin metal films, such frictional wear during insertion may permanently damage these films, rendering the circuit inoperative and requiring replacement. With the increased use of extremely abrasive substrates, such as ceramics, frictional impingement of contacts on such substrates may cause damage to both the contacts and the substrate. Contact elements are often plated with a thin layer of gold for environmental protection, which may be easily abraded away if frictionally contacted with an abrasive material, making it subject to environmental attack and subsequent failure.

Connectors which act to eliminate contact with the circuit structure during insertion generally use separate elements such as actuation plates or rotatable cam shafts which are manually inserted or rotated after insertion of the circuit card to engage the contact elements against the circuit card. Such connectors provide for low or zero force insertion while eliminating frictional wear, but give no frictional impingement in the contact terminal area of the circuit card so as to wipe away unwanted oxides thereby ensuring a good electrical connection. Prior art connectors which are automatically activated by the circuit card itself during insertion, forcing the contact against the circuit card and providing for removal of unwanted oxides, require a multitude of separate components, such as connector housings, contact elements, cams, cam shafts, and activation gears. Where the circuitry of the circuit card is densely packed and the contact elements of the connector are in close proximity, it becomes almost impossible to manufacture and assemble a reliable connector with such a large number of parts. It is therefore one of the objects of this invention to provide an electrical connector with a lesser number of parts, easily manufactured and assembled even where tolerances are critical, than has heretofore been possible, to accomplish the non-contacting of the connector contact through a predetermined distance of insertion.

It is thus another object of this invention to contact a circuit card during insertion in such a manner that the insertion force required and the frictional wear on the circuit card are minimized with a lesser number of connector parts than was heretofore possible.

It is still another object of this invention to effect the contact of the circuit card with the connector contact element in such a manner that the resilient contact will wipe away any oxide or other contaminant on the circuit card contact terminal so as to reliably engage the base metal with a lesser number of parts than was heretofore possible by prior art connectors.

Many materials used as substrates for circuit cards, especially non-flexible ceramics, contain inherent warpage which when inserted into a completely rigid connector cause a large variation of contact force between the contact elements and the circuit card along the curved surface. At its worse case, such a variation results in zero contact between certain contact elements and the circuit card. It is accordingly another object of this invention to provide for the insertion of curved or excessively warped circuit cards while maintaining reliable electrical connections.

## SUMMARY OF THE INVENTION

More particularly, the above objects are accomplished by two basic components, a plurality of resilient U-shaped elements and two separate halves making up a rigid conformal housing. The resilient U-shaped elements, are composed of two arms, some or all of which form a contact carrying member for making electrical contact to lands on a circuit card inserted into the U while non-contacting arms of the U-shaped elements act as helper members; and a rigid conformal housing made up of at least two sections or halves, supported by both arms of the U-shaped elements, and forming a cavity into which the circuit card is inserted. The housing is so shaped along the depth of the insertion cavity so as to be moved away from the center line of the insertion cavity by the circuit card during initial insertion and cause the separation of the resilient U-shaped elements upon which it is supported, preventing engagement of the contact points of the contact carrying members of the resilient, U-shaped elements to the circuit card. Additionally, the housing is so shaped so that upon further insertion of the circuit card the sections of the housing are forced to pivot causing the contact points of the contact carrying members of the resilient U-shaped elements to engage the circuit card and wipe only the contact terminal area.

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the preferred embodiment of the connector in accordance with the invention with a portion of a circuit card also shown in association with the electrical connector.

FIG. 2 is a top view of the connector before circuit card insertion.

FIG. 3 is a top view of the connector after insertion of a substantially warped circuit card for purposes of illustrating the function of the reduced thickness areas and intermediate support members.

FIGS. 4a through 4d are cross-sectional views of the connector taken generally along line 4—4 of FIG. 1 at various points of insertion of the circuit card.

FIG. 4a shows the circuit card at the beginning of insertion at the point of initial contact with the actuation surface of the connector housing.

FIG. 4b shows the circuit card at the depth of insertion where the resilient U-shaped elements have been forced a maximum distance apart by the connector housing.

FIG. 4c depicts the circuit card in contact with the housing pivot surfaces whereby the housing sections have pivoted upon the U-shaped elements allowing the contacting member of the U-shaped element to engage the circuit card.

FIG. 4d shows the circuit card completely inserted and resting on the card stop abutment.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1, 2 and 3 with particular reference to FIG. 3, a circuit card 1, containing terminal areas 1a, which are to be electrically contacted with the connector, is shown inserted into a housing 2 which is made up of sections 2a and 2b and which form an insertion cavity 3. To impart flexibility to the relatively rigid housing 2, reduced thickness areas 4 are formed to allow the housing to conform to the general shape of the circuit card, even when the circuit card is substantially warped. Thus, the housing 2 is referred to as a conformal housing. The connector of the preferred embodiment is designed to receive a circuit card with dimensions in the order of 2x2x0.1 inches with densely packed circuitry as required by advanced technology microcircuits. Thus, although the conformal housing with a single reduced thickness area on each section as shown in FIGS. 1-3 would generally impart sufficient flexibility to allow it to conform to the shape of that size card, additional reduced thickness areas may be necessary for larger cards. In order to give additional support to the conformal housing at the weakened reduced thickness areas 4, intermediate support members 5 are provided as required.

The ends of the insertion cavity 3 are defined by the end support members 6 of the conformal housing 2, the sections of which are forced against each other by the resilient U-shaped elements 7 upon which the conformal housing rests. The U-shaped element 7 electrically contacts the terminal areas 1a, during insertion of the circuit card 1 into the U. The U-shaped element 7, along with the conformal housing 2 make up the two basic components of the connector. The U-shaped elements may be embedded into any suitable material, forming a contact element carrier 8 and also protruding therein are pins 9 which are extensions of the U-shaped elements. Also attached to the contact element carrier 8 are intermediate support members 5 which absorb the force exerted by the U-shaped element on the reduced thickness areas 4 to maintain the shape of insertion cavity 3. The conformal housing 2 is mounted on elements 7 at the housing channels 10. Two adjacent housing channels form between them a housing protrusion 11 which help to maintain a gap 12 between adjacent U-shaped elements to prevent electrical contact between those elements.

Referring now to FIG. 4, the U-shaped element 7 is shown made up of two members, a contact carrying member 13 and a helper member 14. The contact carrying member comprises a contact point 15, a forward tang 16 and a rear tang 17. The contact point 15 makes

electrical contact with the inserted circuit card 1 while the forward tang 16 is pressed against by the housing, thereby forcing the contact point 15 against the inserted card as seen in FIG. 4d. The conformal housing 2b is generally supported by that area of the contact carrying member between the forward tang 16 and the rear tang 17. The helper member 14 of the U-shaped element 7 aids in forcing the contact carrying member against the inserted card and consists of a rear tang 18 containing a recess 19 upon which the conformal housing 2a rests and at which point, force is applied to the housing by the helper member 14. Forming part of the housing channel 10 (as shown in FIG. 1) are channel protrusions 20a and 20b (best seen in FIGS. 4a-4d) which rest on, pivot about, and are forced against the helper member and the contact carrying member. The manner in which the sections of the conformal housing 2 pivot and move with respect to the resilient U-shaped elements 7 during insertion of the circuit card 1 will be more clearly explained in the statement of operation.

The insertion cavity 3 which is defined by the conformal housing 2 is made up of actuation surfaces 21 which form the upper longitudinal walls of the insertion cavity and angle inwardly so that during insertion of the circuit card they contact the card at some distance below the uppermost region of the cavity and are forced apart by the circuit card. Directly below the actuation surfaces on the longitudinal walls of the insertion cavity are contained pivot surfaces 22 which upon contact with the circuit card (FIG. 4c) cause the sections of the housing to pivot on the resilient U-shaped elements 7. At the bottom of the insertion cavity is a card stop abutment 23 which prevents further insertion of the circuit card.

#### STATEMENT OF OPERATION

The operation of this device is explained with reference to FIGS. 4a, 4b, 4c and 4d. FIG. 4a illustrates the position of the elements of the connector at the beginning of the circuit card insertion as generally seen along line 4-4 of FIG. 1. Circuit card 1 is inserted into the insertion cavity 3, formed by the sections of the conformal housings 2a and 2b, the width of the cavity at its uppermost region being somewhat larger than the thickness of the circuit card. The circuit card first contacts the actuation surfaces 21 of the housing at some distance below the uppermost region of the cavity as shown in FIG. 4a.

FIG. 4b illustrates the position of the contact elements after further insertion of the circuit card 1 along the actuation surfaces 21. The resilient U-shaped element 7 is thereby separated a maximum distance away from the center line of the insertion cavity. Separation of the conformal housing 2 during insertion, forces the resilient U-shaped elements 7, which are in contact with the housing at the housing channels 10 as shown in FIG. 1, away from the center line of the insertion cavity. Protrusions 20a and 20b upon insertion of the circuit card 1 along the actuation surface 21 of the conformal housing force the contact carrying members and the helper members of the resilient U-shaped elements away from the center line of the insertion cavity.

Upon further insertion of the circuit card 1 as shown in FIG. 4c, the card contacts pivot surfaces 22 of the conformal housing which are directly below the actuation surfaces 21 and which make up the longitudinal walls adjacent the bottom of the insertion cavity 3.

Pivot surfaces 22 angle inward with respect to the cavity and upon contact with the circuit card 1 cause the sections of the housing to pivot on radii 60a and 60b, of elements 13 and 14, respectively. Pivoting of the housing permits the contact carrying member rear tang 17, which is in contact with the housing, to move towards the center line of the insertion cavity. Simultaneously, pivoting of the housing causes the housing channel protrusion 20b to move up recess 19 of the helper member 14, thus displacing the rear tang 18 and causing the helper member to move away from the center line of the insertion cavity. With sufficient rotation of the housing sections, the contact point 15 of the contact carrying member engages the circuit card 1 at some distance away from its edge. The point of engagement may be controlled by the slope of the pivot surfaces 22, such point being generally chosen to avoid contacting the circuit card substrate but yet contacting and wiping the circuit card contact terminals 1a.

FIG. 4d illustrates the circuit card 1 at its fully inserted position, resting on card stop abutment 23 of the conformal housing. From the point of initial engagement of contact point 15 with circuit card 1 through full insertion, contact point 15 remains engaged with the circuit card 1 so as to wipe the circuit card through a controlled distance. The conformal housing at the bottom of pivot surfaces 22 also remain in contact with the circuit card 1 so as to provide additional points to retain the inserted circuit card thus preventing any rocking or movement of the inserted card within the connector. The retaining force on both sides of the inserted card are generally equalized and increased through the helper member 14 of the resilient U-shaped member 7 which is generally described in my copending application, "Connector with Load Sharing Contacts," Ser. No. 866,560 and assigned to the same assignee as the instant application. At the position of complete insertion, helper member 14 is deflected a maximum distance away from the center line of the insertion cavity by housing protrusion 20b. At maximum deflection the helper member exerts a maximum force against the rigid-conformal housing, the force being transferred to adjacent carrying members 13 on the same side of the circuit card, through contact of the conformal housing with the forward tang 16 of the contact carrying member. Thus, contact point 15 is forced against the circuit card ensuring intimate electrical contact and snug retention of the circuit card within the connector.

Returning to FIGS. 2 and 3 which represent the connector before and after insertion of a warped circuit card, the advantage of the reduced thickness areas 4 may be readily seen. Reduced thickness areas 4 provide points at which the generally rigid conformal housing 2 may bend to better conform to the curve of the circuit card, thus ensuring good electrical contact with the circuit card. A plurality of such reduced contact areas 4 with intermediate support members 5 may be provided to reduce the amount of deflection at any given point.

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.

Such changes will often be dictated by the size and shape of the card as well as its circuit configuration. For example, if circuitry is contained on only one side of the circuit card, the contact carrying members of the U-shaped elements are only necessary on one side of the circuit card. For such a circuit configuration all the helper members may be placed on the back side of the card while all the contact carrying members may be positioned on the circuit side. However, for such a configuration there may be insufficient points of frictional engagement on the back side of the card for proper retention of the circuit card. Contact carrying members may be positioned on the back side of the substrate in order to provide sufficient point for frictional engagement. Also, in such a configuration, helper members may be positioned on the circuit side of the card to increase the force exerted by the contact carrying members. The number and order of contact carrying members and helper members will vary with circuit configuration and the distance between terminals. Also, all terminals need not be an equal distance from the edge of the card as shown in the preferred embodiment. Thus, the size of the helper or contact carrying member or the position of the contact point on the contact carrying member may vary within a connector. For larger circuit cards than that shown in the preferred embodiment, a greater number of reduced thickness areas may be provided or the conformal housing may be made up of more than two sections.

What is claimed is:

1. A connector with control wipe characteristics comprising:
  - a plurality of resilient U-shaped elements, each with a contact carrying member on one arm of each U-shaped element for making electrical contact to terminals on a circuit card inserted into the U, a helper member on the other arm of said U-shaped element, said contact carrying members and said helper members being arranged on both sides of the circuit card so that the members of the two adjacent U-shaped elements on the same side of the circuit card form a gap between them and
  - a rigid conformal housing, made up of a plurality of sections, containing channels, said housing resting upon both the contact carrying members and helper members of the U-shaped elements at said channels;
  - the sections of said housing resting upon one arm of each U-shaped element, forming a cavity into which the circuit card is inserted;
  - an actuation surface angling inward so as to decrease the opening of said cavity with increased depth to a distance less than the thickness of the circuit card at some distance below the uppermost region of said cavity;
  - said channels of said housing having protrusions to form pivot points with said contact carrying members and said helper members, upon which points said housing pivots;
  - said housing having a pivot surface below said actuation surface and angling inward with respect to said cavity so as to provide a surface which said circuit card contacts during and after insertion, contact by the circuit card with said pivot surface forcing said housing to pivot on the housing channel protrusions causing said contact carrying members to engage and wipe the circuit card.

2. The connector of claim 1 wherein the members of the adjacent U-shaped elements having a gap between them consist of said contact carrying member positioned adjacent the circuit structure and said helper member positioned on the other side of the gap.

3. The connector of claim 1 wherein the housing members have a card stop abutment surface at the bottom region of said cavity.

4. The connector of claim 1 wherein the contact carrying member of the U-shaped element has a forward tang towards the center of the U-shaped element and a rear tang away from the center of the U-shaped element, said tangs projecting into the housing channel and around a channel protrusion, said protrusion shaped so as to cause the housing to move said member as well as pivot on said member during circuit card insertion and said protrusion shaped so as to cause the housing to apply a force against said member in the direction of the card after insertion.

5. Claim 1 wherein the helper member of the U-shaped element has a rear tang away from the center of the U-shaped element, said tang projecting into the channel housing and around a channel protrusion, said protrusion shaped so as to cause the housing to move said member as well as pivot on said member during circuit card insertion and said protrusion shaped so as to cause said helper member to apply a force against said housing in the direction of the card after insertion.

6. The connector of claim 1 wherein the housing has at least one reduced thickness portion whereby said housing is free to bend and conform to the shape of the circuit card.

7. The connector of claim 5 wherein intermediate support members are attached to the housing at reduced thickness areas.

8. A connector with control wipe characteristics comprising:  
 a plurality of resilient U-shaped elements each with a contact carrying member on one arm of each U-shaped element for making electrical contact to terminals on a circuit card inserted into the U, a helper member on the other arm of said U-shaped element, said contact carrying member and said helper member being arranged on both sides of the circuit card so that the helper members and the contact carrying members of two adjacent U-shaped elements on the same side of the circuit card have a gap between them;  
 a rigid conformal housing, made up of a plurality of

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sections, containing channels with channel protrusions and resting upon both the contact carrying members and the helper members of the U-shaped elements at said channels;

said contact carrying members having a forward tang towards the center of the U-shaped elements and a rear tang away from the center of the U-shaped element, said forward tang projecting into the housing channel and around a housing protrusion; said helper member of the U-shaped element having a rear tang away from the center of the U-shaped element, said rear tang projecting into a housing channel and around a channel protrusion; and said protrusions shaped so as to move the U-shaped element members as well as allow the conformal housing to pivot on said members during circuit card insertion and said protrusions shaped so as to apply a force on said members after card insertion so that the helper members of the U-shaped elements apply a force against the housing in the direction of the card and the housing members apply a force against the contact carrying members in the direction of the card;

the sections of said housing resting upon each arm of the U-shaped element and forming a cavity into which the circuit card is inserted;

an actuation surface angling inward so as to decrease the opening of said cavity with increased depth to a distance less than the thickness of the circuit card, at some distance below the uppermost region of said cavity;

said housing having a pivot surface below said actuation surface and angling inward with respect to said cavity so as to provide a surface which said circuit card contacts during and after insertion, contact by the circuit card with said pivot surface forcing said housing to pivot on said channel protrusions, causing contact of said contact carrying members to engage and wipe said circuit card;

said housing members having a card stop abutment at the bottom region of said cavity.

9. The connector of claim 8 wherein the thickness of the housing is reduced at certain areas whereby said housing is free to bend and conform to the shape of the circuit card.

10. The connector of claim 9 wherein intermediate support members are attached to the housing at the reduced thickness areas.

\* \* \* \* \*

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,763,462 Dated October 2, 1973

Inventor(s) Mario Enrique Ecker

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 42, the word "form" should read --have--.

Signed and sealed this 5th day of March 1974.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents