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54 Low insertion force electrical connector with stress controlled contacts.

57 Multiple contact electrical connector with stress controlled connector spring contacts (40) is provided for use in making electrical contact with a plurality of conductive pads (54, 56) formed along an insertable edge (58) of a printed circuit board (12). The contacts (40) are mounted in slots (38) formed along an elongated cavity (14) in a connector housing (13). Each spring contact (40) includes opposed, deflectable contacting portions (50, 52) for engaging the conductive pads (54, 56). Portions (50, 52) are at different elevations to define an opening through which the edge (58) of the printed circuit board may be inserted in the cavity (14) with low or zero insertion force. Subsequently, the printed circuit board is rotated upright into a final contacting position, in which the conductive pads (54, 56) engage and deflect the contacting portions (50, 52) with a relatively high contact force. The connector housing includes first and second integrally formed stop faces (46, 48) respectively associated with each of the opposed contacting portions (50, 52) that control or limit the deflection of the contacting portions and the resultant stress imparted to the spring contacts. Latches (28) hold the printed circuit board (12) in its upright position against further stop faces (60) or posts (20, 22).

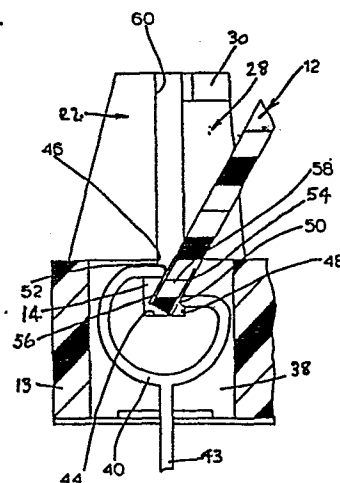


FIG. 2

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LOW INSERTION FORCE ELECTRICAL CONNECTOR
WITH STRESS CONTROLLED CONTACTS

The present invention generally relates to electrical connectors for making electrical connections to printed circuit boards and concerns, more particularly, low insertion force electrical connectors for making electrical connections to conductive strips mounted along the edges of printed circuit boards.

Low insertion force electrical connectors for making electrical connections to conductive strips disposed generally in parallel along opposite sides of an elongated edge of a printed circuit board are old and well known in the prior art. Examples of such devices and electrical contacts for such devices are disclosed in United States Letters Patents Nos. 3,701,071; 3,795,888; 3,920,303; 3,848,952; 4,136,917; and Re.26,692. The electrical connectors disclosed in such patents receive printed circuit boards with low insertion force in order to limit the wear of the spring contacts associated with the electrical connectors and the conductive strips associated with the printed circuit boards.

While many prior art electrical connectors have been able to provide low insertion force electrical

connections with printed circuit boards, such devices typically do not provide fixed connector housing stops for directly contacting the printed circuit boards to limit the amount of contact force and resultant stress applied to the connector spring contacts. The possibility of overstressing the spring contacts thus exists which could result in a reduction of the effectiveness of the electrical connection between the spring contacts and the conductive strips on the printed circuit boards. A need exists for electrical connectors having housings that directly contact the printed circuit boards to limit the amount of deflection of the spring contacts mounted therein.

An object of the present invention is to provide a new and improved electrical connector of this kind.

The present invention provides a low insertion force electrical connector having an elongated insulating housing and a cavity formed along the length of the insulating housing for receiving the insertable edge of a printed circuit board. Disposed within the cavity at spaced apart intervals is a plurality of spring contacts for making high contact force electrical connections with a plurality of spaced apart, generally parallel, conductive strips formed on opposite sides of and along the length of

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the edge of the printed circuit board. Each spring contact includes a pair of spaced apart contacting portions that define an opening through which the edge of the printed circuit board may be received.

5 Very low or zero insertion force is required to dispose the printed circuit board in the cavity. Upon the complete insertion of the edge of the printed circuit board, the board is pivoted or rotated until it is disposed in a final or contact position in
10 which the spaced apart contacting portions of the spring contacts physically and electrically engage with high contact force the conductive strips formed along the edge of the printed circuit board. An integrally formed portion of the connector housing
15 forms a limit or stop to prevent excess rotational or pivotal movement of the printed circuit board. In this manner, excess deflection of the contacting portions of the spring contacts is prevented.

One way of carrying out the invention is
20 described in detail below by way of example, and not by way of limitation, and with reference to drawings which illustrate only the specific embodiment. In the drawings:-

FIG. 1 is a perspective view of a printed
25 circuit board and of an electrical connector for use therewith constructed in accordance with the

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principles of the present invention;

FIG. 2 is a fragmentary cross sectional view of the electrical connector of FIG. 1 depicting the printed circuit board in its initial or inserted
5 position in the electrical connector; and

FIG. 3 is a fragmentary cross sectional view similar to the view of FIG. 2 depicting the printed circuit board in its final or contact position in the electrical connector.

10 Referring to the drawings, the low insertion force, multiple contact electrical connector 10, is for use in making electrical connections to a conventional printed circuit board 12. While the electrical connector 10 is depicted and described
15 herein as being capable of receiving and making electrical connections to two printed circuit boards 12, the principles of the present invention disclosed herein are equally applicable to electrical connectors suitable for use in making electrical
20 connections to a single printed circuit board 12 or to a plurality of three or more printed circuit boards 12.

The electrical connector 10 includes an elongated housing 13, formed from any suitable
25 insulating material, having a pair of elongated,

spaced apart, access cavities 14 and 16 formed along an elongated base 18 and a plurality of four upstanding circuit board support or retention posts 20, 22, 24 and 26. Each of the posts 20, 22, 24, 5 26 includes an integrally formed, resilient or yieldable latch 28 formed at the upper end thereof for yieldably retaining a printed circuit board 12 in a final or contact position between associated pairs of the posts 20, 22 and 24, 26. More 10 specifically, each latch 28 includes an elongated tapered surface 30 formed at its free end that is capable of being outwardly deflected upon contact with one of the spaced apart lateral edges 32 and 34 of the printed circuit board 12. When the printed 15 circuit board 12 is fully received within a pair of spaced apart cavities 36, formed in the posts 20, 22, 24, 26, the associated resilient latches 28 return to their nondeflected position (FIG. 1) to retain the printed circuit board 12 in its final or contact 20 position.

Each access cavity 14 and 16 includes a plurality of generally parallel, spaced apart, transversely oriented slots 38 disposed along substantially its entire length. A connector spring 25 contact 40 (FIGS. 2 and 3), formed from any suitable resilient electrically conductive metallic material,

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such as a strip of beryllium copper having a thickness of approximately .015 inch (0.38 mm), is disposed in each one of the slots 38. If desired, the spring contact 40 disposed in a slot 38 along the cavity 14 (for example, the slot 38a) may be electrically short circuited to the spring contact 40 disposed in a longitudinally aligned or otherwise associated slot 38 along the cavity 16 (for example, the slot 38b). This may be achieved by forming the spaced apart spring contacts 40 in the slots 38a and 38b as integral portions of a single electrically conductive metallic strip. Alternatively, the spring contacts 40 in the access cavities 14 and 16 may be electrically insulated from each other. Each of the access cavities 14 and 16 also includes an elongated, inclined, insertion surface 42, a bottom surface 44, an inwardly protruding shoulder, stop or limit surface 46, and a vertically extending surface 48 disposed between the inclined surface 42 and the bottom surface 44.

Since the configuration and operation of the spring contacts 40 disposed in the slots 38 along the cavities 14 and 16 are essentially the same, only one such spring contact 40 is discussed in detail hereinafter. Each spring contact 40 is stamped and integrally formed to have a rounded continuously curved configuration with first and second free ends

50 and 52 having contact surfaces disposed at different elevations in its cavity 14, 16, for respectively contacting conductive pads or strips 54 and 56 disposed along opposite sides of an insertable edge 58 of the printed circuit board 12, a central portion 41 disposed between said free ends 50 and 52 and a mounting leg 43 extending from said central portion. By disposing the contact surfaces 50 and 52 at different elevations within the slot 38 in the cavity 14, 16, corresponding respectively to the elevational dispositions of the surface 48 and of the surface 46, the printed circuit board 12 may be inserted at an angle (Fig. 2) to its final or contact position (Fig. 3) in the cavity 14. The insertion angle or orientation of the printed circuit board 12 is generally parallel to the angle or orientation of the inclined surface 42. In this manner, low or zero insertion force is required to insert the edge 58 into the cavity 14, thereby minimizing undesirable wear on the conductive strips 54 and 56 and the spring contacts 40. The inclined surface 42 may be used as a guide surface for the insertion of the printed circuit board 12.

The mounting legs 43 of the contacts 40 resiliently mount the contacts 43 for freedom of movement and after insertion of the printed circuit

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board 12, the printed circuit board may be pivoted or rotated about the contacting portion 50 or the surface 48 until it assumes a final or contact position (FIG. 3) in which position the printed circuit board 12 rests against the bottom surface 44 and its lateral edges 32 and 34 are retained in the cavities 36 in the spaced apart posts 20 and 22. In this final or contact position, the contacting portions 50 and 52 are resiliently deflected outwardly from the center of the cavity 14 by their respective engagements with the conductive strips 54 and 56. The configuration of the spring 40 and of its contacting portions 50 and 52 is such as to provide a relatively high contact force between the contacting portions 50 and 52 and the conductive strips 54 and 56.

The deflection of the contacting portion 52, disposed at the same elevation and in an overlying relationship with the surface 46, and the resultant stress imparted to the spring contact 40 is limited by the stop or limit surface 46. That is, the contacting portion 52 cannot be deflected beyond the inwardly extending limit surface 46 since the limit surface 46 will physically engage the edge 58 of the printed circuit board 12 to limit its pivotable or rotational movement within the cavity 14. By aligning the

vertically extending interior surfaces 60 (FIGS. 2 and 3) of each post 20, 22, 24, 26 with the stop or limit surface 46, the pivotal or rotational movement of longitudinally extending portions of the lateral edges 32 and 34 disposed above the cavity 14 is also limited. The vertically extending surface 48 may also serve as a stop or limit surface to control or limit the amount of deflection of the contacting portion 50 of the spring contact 40 since the contacting portion 50 is similarly disposed generally at the same elevation and in an overlying relationship with the surface 48.

A low insertion force electrical connector 10 has been described for making effective and reliable high contact force electrical connection with a printed circuit board 12 while reducing or preventing the possibility of overstressing the spring contacts 40 of the electrical connector 10.

Rather than being formed as an uninterrupted surface, the stop or limit surface 46 (and, if desired, the surfaces 42 and/or 48) may be formed as a plurality of spaced apart stops or limit surfaces 46 associated with each slot 38 and each contacting portion 52. In addition, the precise configuration of the spring contacts 40 may be modified to achieve desired spring and contact characteristics.

CLAIMS:

1. An electrical connector (10) for a printed circuit board (12) having a mating edge (58) and first and second opposed surfaces with a plurality of contact pads (54, 56) on each surface adjacent
5 said edge, said connector including an elongated dielectric housing (13) with a cavity (14 or 16) formed along its length for receiving the printed circuit board mating edge, a plurality of spring
10 contacts (40) mounted in the housing to engage the printed circuit board (12) contact pads when the printed circuit board is inserted in the cavity at a first angular position and subsequently pivoted to a second angular position characterized in that each
15 of said spring contacts (40) is stamped and integrally formed to have a rounded continuously curved configuration with first and second free ends (50, 52) having contact surfaces disposed at different elevations in said cavity (14 or 16), a central portion
20 (41) disposed between said free ends, a mounting leg (43) extending from said central portion for resilient mounting of said contact member with freedom of movement as said printed circuit board (12) is pivoted in said cavity between said first and second angular positions,
25 and in that said housing further includes first and

and second integrally formed limit surfaces (46, 48) disposed immediately adjacent said spring contact surfaces (50, 52) and said printed circuit board contact pads (54, 56) when said printed circuit board (12) is inserted in said cavity (14 or 16), said limit surfaces being arranged to directly physically contact each said printed circuit board surface to limit deflection of said spring contacts while maintaining the freedom of movement of said spring contacts as said printed circuit board is pivoted in said cavity.

2. An electrical connector as claimed in claim 1 wherein said cavity (14 or 16) includes an inclined surface (42) disposed at an angle to said first limit surface (46), said inclined surface and said first limit surface being generally spaced apart across the opening to said cavity (14 or 16).

3. An electrical connector as claimed in claim 1 wherein said housing (13) further comprises means (20, 22, 24, 26) for retaining said housing in a contact position in which position said spring contacts (40) electrically contact said edge (58) of said printed circuit board (12).

4. An electrical connector as claimed in claim 3 wherein said retaining means comprises a pair of spaced apart latches (28) disposed above said

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cavity for retaining said printed circuit board
in said contact position.

