

Description

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.

DE-B-2,537,281 describes a low insertion force connector for a printed circuit board comprising a housing having a limit surface which determines the final rotated position of a printed circuit board relative to the connector spring contacts and in which the contacts make electrical connection with the printed circuit board conductive strips.

US-A-3,848,952 describes a low insertion force connector for a printed circuit board in which forked spring contacts receive the circuit board mating edge in their forks prior to rotation of the board to make electrical contact. The forked spring contacts are at different levels in the connector housing and the forks are resiliently mounted each on a spring arm having a vertically and a horizontally disposed lengthwise portion which provides for X-Y displacement of each fork in a single plane to allow the forks to move freely to receive the printed circuit board mating edge with low insertion force. The forks themselves are relatively stiff and the contact pressure is achieved by deflection of the spring arms upon rotation of the board and resulting from a corresponding rotation of the forks.

US-A-4,136,917 describes a low insertion force connector which axially adjusts the printed circuit board to align its contact pads with the connector contacts as the printed circuit board is

rotated into its final position to achieve the contact pressure. The connector spring contacts are fork-shaped providing two spring leg portions, one of which is straight and the other of which is connected through a curved portion to the straight leg portion. The straight leg portion extends perpendicularly to a transverse web portion of the contact which fixedly mounts the contact in the connector housing. On the free ends of the leg portions there are provided contact noses which face each other but are on different levels, the one on said other leg portion, connected through the curved contact portion, being the lower. Rotation of the printed circuit board following insertion of the mating edge of the board between the legs of the forks brings the contact noses into contact with the board, to make electrical contact with the contact pads on the board.

A need exists for electrical connectors having housings that directly contact the printed circuit boards on both sides 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 for a printed circuit board having a mating edge with a plurality of contact pads adjacent said edge, said connector including an elongated dielectric housing with a cavity formed along its length for receiving the printed circuit board mating edge, a plurality of spring contacts mounted in the housing to engage the printed circuit board 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, wherein each of said spring contacts is stamped and integrally formed to have a rounded continuously curved configuration, said housing further including an integrally formed limit surface disposed immediately adjacent said spring contacts and said printed circuit board contact pads when said printed circuit board is inserted in said cavity, said limit surface being arranged to directly physically contact said printed circuit board mating edge to limit deflection of said spring contacts characterised in that each of said spring contacts has first and second free ends having contact surfaces disposed at first and second elevations at respective sides of said cavity to make electrical contact with contact pads disposed on respective first and second opposed surfaces of said printed circuit board, said free ends being disposed on the respective ends of a central, generally C-shaped portion of the contact, the contact further including a mounting leg extending downwardly from the central portion intermediate the ends thereof and providing the sole support for said C-shaped portion, whereby said C-shaped portion is resiliently mounted to have freedom of movement as the printed circuit board is pivoted in said cavity between said first and second angular positions, said integrally formed limit surface

directly physically contacting that one of the opposed surfaces of the printed circuit board contacted by one free end of said C-shaped portion to limit the deflection of said one free end of said C-shaped portion in a direction away from its other free end and in that said housing has a further one of said limit surfaces which directly physically contacts the other of the opposed surfaces of the printed circuit board to limit the deflection of the other free end of said C-shaped portion in a direction away from said one free end thereof.

One way of carrying out the invention is 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 circuit board and of an electrical connector for use herewith constructed in accordance with the 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 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.

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 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 connections to a single printed circuit board 12 to a plurality of three or more printed circuit boards 12.

The electrical connector 10 includes an elongated housing 13, formed from any suitable 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, 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 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 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 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 contact 40 (FIGS. 2 and 3), formed from any suitable resilient electrically conductive metallic material, 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 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) with a plurality of contact pads (54, 56) adjacent said edge, said connector including an elongated dielectric housing (13) with a cavity (14; 16) formed along its length for receiving the printed circuit board mating edge, a plurality of spring contacts (40) mounted in the housing to engage the printed circuit board 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, wherein each of said spring contacts (40) is stamped and integrally

formed to have a rounded continuously curved configuration, said housing further including an integrally formed limit surface (46; 48) disposed immediately adjacent said spring contacts (40) and said printed circuit board contact pads (54, 56) when said printed circuit board (12) is inserted in said cavity (14; 16) said limit surface being arranged to directly physically contact said printed circuit board mating edge (58) to limit deflection of said spring contacts characterized in that each of said spring contacts (40) has first and second free ends (50, 52) having contact surfaces disposed at first and second elevations at respective sides of said cavity (14; 16) to make electrical contact with contact pads (54, 56) disposed on respective first and second opposed surfaces of said printed circuit board (12), said free ends being disposed on the respective ends of a central, generally C-shaped portion (41) of the contact (40) the contact further including a mounting leg (43) extending downwardly from the central portion (41) intermediate the ends thereof and providing the sole support for said C-shaped portion, whereby said C-shaped portion (41) is resiliently mounted to have freedom of movement as the printed circuit board (12) is pivoted in said cavity between said first and second angular positions, said integrally formed limit surface (46; 48) directly physically contacting that one of the opposed surfaces of the printed circuit board (12) contacted by one free end of said C-shaped portion (41) to limit the deflection of said one free end of said C-shaped portion in a direction away from its other free end and in that said housing (13) has a further one of said limit surfaces (46, 48) which directly physically contacts the other of the opposed surfaces of the printed circuit board (12) to limit the deflection of the other free end of said C-shaped portion (41) in a direction away from said one free end thereof.

2. An electrical connector as claimed in claim 1 wherein said cavity includes an inclined surface (42) disposed at an angle to the limit surface (46) associated with the free ends of the C-shaped portions of the contacts disposed at the higher level in said cavity and generally spaced apart therefrom across the opening to said cavity (14; 16).

3. An electrical connector as claimed in claim 1 wherein said housing (13) further comprises means (20, 22, 24, 26) for retaining said printed circuit board (12) in a contact position in which position said spring contacts (40) electrically contact said pads (54, 56) 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 cavity for retaining said printed circuit board in said contact position.

Patentansprüche

1. Elektrischer Verbinder (10) für eine Leiterplatte (12), die einen Paßrand (58) mit einer



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Mehrzahl von Kontaktstreifen (54, 56) an diesem Rand aufweist, wobei der Verbinder ein langgestrecktes dielektrisches Gehäuse (13) mit einer Ausnehmung (14; 16) besitzt, die über ihre Länge zur Aufnahme des Leiterplattenpaßrandes ausgebildet ist, eine Mehrzahl von Federkontakten (40) in dem Gehäuse für einen Eingriff mit den Kontaktstreifen der Leiterplatte beim Einsetzen der Leiterplatte in die Ausnehmung mit einer ersten Winkelstellung und anschließend Schwenken in eine zweite Winkelstellung angebracht ist, jeder der Federkontakte (40) gestanzt und einstückig derart geformt ist, daß er eine abgerundete fortlaufend gekrümmte Gestalt aufweist, das Gehäuse ferner eine einstückig angeformte Anschlagfläche (46; 48) aufweist, die unmittelbar an die Federkontakte (40) und die Kontaktstreifen (54, 56) der Leiterplatte angrenzend angeordnet ist, wenn die Leiterplatte (12) in die Ausnehmung (14; 16) eingesetzt ist, und die Anschlagfläche derart angeordnet ist, daß sie den Leiterplattenpaßrand (58) zur Begrenzung einer Auslenkung der Federkontakte direkt körperlich berührt, dadurch gekennzeichnet, daß jeder der Federkontakte (40) ein erstes und ein zweites freies Ende (50, 52) mit Kontaktflächen aufweist, die auf einer ersten und einer zweiten Höhe an den jeweiligen Seiten der Ausnehmung (14; 16) zur Herstellung eines elektrischen Kontakts mit Kontaktstreifen (54, 56) angeordnet sind, die auf jeweiligen ersten und zweiten einander gegenüberliegenden Flächen der Leiterplatte (12) angeordnet sind, die freien Enden an dem jeweiligen Ende eines mittleren, im allgemeinen C-förmigen Bereichs (41) des Kontakts (40) angeordnet sind, der Kontakt ferner einen Montageschenkel (43) aufweist, der sich nach unten von dem zentralen Bereich (41) zwischen dessen Enden erstreckt und die einzige Abstützung für den C-förmigen Bereich darstellt, wodurch der C-förmige Bereich (41) federnd derart montiert ist, daß er über eine Bewegungsfreiheit verfügt, wenn die Leiterplatte (12) in der Ausnehmung zwischen der ersten und der zweiten Winkelstellung verschwenkt wird, die einstückig gebildete Anschlagfläche (46, 48) direkt körperlich diejenige der einander gegenüberliegenden Oberflächen der Leiterplatte (12) berührt, die von einem freien Ende des C-förmigen Bereichs (41) berührt wird, um die Auslenkung dieses einen freien Endes des C-förmigen Bereichs in von dessen anderem freien Ende fortweisender Richtung zu begrenzen, und daß das Gehäuse (13) eine weitere dieser Anschlagflächen (46, 48) aufweist, die direkt körperlich die andere der einander gegenüberliegenden Oberflächen der Leiterplatte (12) zur Begrenzung der Auslenkung des anderen freien Endes des C-förmigen Bereichs (41) in von dessen einem freien Ende fortweisender Richtung berührt.

2. Elektrischer Verbinder nach Anspruch 1, bei dem die Ausnehmung eine Schrägfläche (42) aufweist, die in einem Winkel zu der Anschlagfläche (46) angeordnet ist, die den freien Enden der C-förmigen Bereiche der Kontakte zugeordnet ist, die in der höheren Ebene in der Ausnehmung

angeordnet sind und im allgemeinen einen Abstand von dieser quer über die Öffnung der Ausnehmung (14; 16) aufweisen.

3. Elektrischer Verbinder nach Anspruch 1, bei dem das Gehäuse (13) ferner Mittel (22, 24, 26) zum Halten der Leiterplatte (12) in einer Kontaktstellung umfaßt, in welcher Stellung die Federkontakte (40) die Streifen (54, 56) der Leiterplatte (12) elektrisch kontaktieren.

4. Elektrischer Verbinder nach Anspruch 3, bei dem die Haltemittel ein Paar mit Abstand voneinander angeordneter Klinken (28) umfassen, die über der Ausnehmung zum Halten der Leiterplatte in der Kontaktstellung angeordnet sind.

Revendications

1. Connecteur électrique (10) pour plaque de circuit imprimé (12) présentant un bord de raccordement (58) avec une série de pastilles de contact (54, 56) adjacentes audit bord, ledit connecteur comprenant un logement diélectrique allongé (13) présentant une cavité (14, 16) pratiquée sur sa longueur pour recevoir le bord de raccordement de la plaque de circuit imprimé, une série de contacts élastiques (40) montés dans le logement pour entrer en prise avec les pastilles de contact de la plaque de circuit imprimé quand la plaque de circuit imprimé est insérée dans la cavité selon une première position angulaire et ensuite pivotée vers une seconde position angulaire, dans lequel chacun des contacts élastiques (40) est estampé et conformé d'une pièce pour présenter une configuration incurvée arrondie continue, ledit logement comprenant de plus une surface de limitation (46, 48) d'une seule pièce, disposée immédiatement adjacente auxdits contacts élastiques (40) et auxdites pastilles de contact de la plaque de circuit imprimé (54, 56) quand ladite plaque de circuit imprimé (12) est insérée dans ladite cavité (14, 16), lesdites surfaces de limitation étant disposées pour être en contact physique direct avec ledit bord de raccordement (58) de la plaque de circuit imprimé, pour limiter le fléchissement desdits contacts élastiques, caractérisé en ce que chacun desdits contacts élastiques (40) présente une première et une seconde extrémité (50, 52) ayant des surfaces de contact disposées à un premier et à un second niveau vers les côtés respectifs de ladite cavité (14, 16) pour créer le contact électrique avec les pastilles de contact (54, 56) disposées respectivement sur la première et la seconde des surfaces opposées de ladite plaque de circuit imprimé (12), lesdites extrémités libres étant disposées aux extrémités respectives d'une partie centrale en forme générale de C (41) du contact (40), le contact comprenant de plus une jambe de montage (43) s'étendant vers le bas à partir de la partie centrale (41) en une position intermédiaire entre les extrémités de cette dernière, et formant le seul support de ladite partie en forme de C, cette dite partie en forme de C (41) étant montée élastiquement pour avoir la liberté de mouvement lorsqu'on fait pivoter la plaque de circuit



imprimé (12) dans ladite cavité entre ladite première et ladite seconde position angulaire, ladite surface de limitation formée d'une pièce (46, 48) étant en contact physiquement direct avec celle des surfaces opposées de la plaque de circuit imprimé (12) en contact avec une extrémité libre de ladite partie en forme de C (41) pour limiter le fléchissement de ladite extrémité libre de ladite partie en forme de C dans une direction s'écartant de l'autre extrémité libre, et en ce que ledit logement (13) présente une autre desdites surfaces de limitation (46, 48) qui entre en contact physique direct avec l'autre des surfaces opposées de la plaque de circuit imprimé (12) pour limiter le fléchissement de l'autre extrémité libre de ladite partie en forme de C (41) dans une direction s'écartant de la première de ces extrémités libres.

2. Connecteur électrique tel que revendiqué à la revendication 1 dans lequel ladite cavité comprend une surface inclinée (42) disposée angulai-

rement par rapport à la surface de limitation (46) associée avec les extrémités libres des parties en forme de C des contacts disposés au niveau supérieur dans ladite cavité et généralement espacée de celle-ci à travers l'ouverture de ladite cavité (14, 16).

3. Connecteur électrique tel que revendiqué à la revendication 1, dans lequel ledit logement (13) comprend de plus des moyens (20, 22, 24, 26) de retenue de ladite plaque de circuit imprimé (12) en position de contact, position dans laquelle lesdits contacts élastiques (40) sont en contact électrique avec lesdites pastilles (54, 56) de ladite plaque de circuit imprimé (12).

4. Connecteur électrique tel que revendiqué à la revendication 3 dans lequel lesdits moyens de retenue comprennent une paire de cliquets (28) espacés et écartés disposés au-dessus de ladite cavité pour retenir ladite plaque de circuit imprimé dans ladite position de contact.

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