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(54) Connector with retention feature
Verbinde mit Haltemitteln
Connecteur avec dispositif de rétention

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Description

This invention relates to electrical connectors of the type having a connector body and a plurality of posts extending out of one side of the connector body for mounting to a circuit board. In particular, this invention relates to an improved retention feature for such electrical connectors for temporarily holding the electrical connector in place on a printed circuit board prior to soldering.

There are various structures formed into the solder tails of connector contacts for retaining the connector in place on the printed circuit board prior to soldering the tails permanently in position. An example of such a structure is disclosed in U.S.-A 2,997,063 which discloses a plurality of solder tails attached to a coil support which are inserted into holes in a substrate. The solder tails are configured to snap into the holes and retain the part in position until soldering is complete. This configuration includes a kneecap portion which engages a corner of the hole under the board and relies upon the diametrically opposed knee to help provide centering so that both knees are effective in holding the coil support against the board. With this structure, the individual leads will engage only one side of the hole thereby requiring significant force from the opposite leads for effective retention. A similar structure is disclosed in Japanese Laid-open U.M Publication No. 57-66270 which discloses a pin header connector where some of the posts include bends for holding the connector to the printed circuit board prior to soldering. Of additional interest is a lead structure for an electrical component that is disclosed in U.S.-A 2,754,486. This patent discloses a lead structure comprising a soft copper, round wire, lead which is bent 90 degrees to the axis of the component and then has a doted kink formed in each wire lead in mutual opposition so that when the two leads are inserted into holes of a printed circuit board the rounded part of the kink engages one side of the hole which urges the free end of the lead into engagement with the other side of the hole. Further engagement causes the free end to extend through the hole and hook under the corner of the board. Such a structure will easily deform past its elastic limit when encountering extreme tolerance variations, partly due to the lack of positional memory of soft copper wire and partly due to the geometry of the structure.

What is needed is a tail structure that will permit the easy insertion of the solder tails of a connector into the holes of a printed circuit board where a selected solder tail will reliably engage opposite sides of its respective hole and snap into place thereby positively urging the connector housing against the surface of the printed circuit board. The tail structure must be sufficiently elastic to permit this operation under extreme limits of tolerance variations of the board and the connector.

The present invention consists in the combination defined in claim 1. WO-A-88/04484 discloses a combination according to the preamble of claim 1. There is disclosed herein a connector having a body and a plurality of posts, each of which has a tail extending out of one side of the body for mounting on a printed circuit board. The board includes first and second spaced, parallel major surfaces and a plurality of through holes extending therebetween. Each hole intersects the first surface at a first corner and the second surface at a second corner. Each of the tails is received in a respective one of the holes with one side of the connector body being substantially parallel and in engagement with the first major surface of the board. A retention feature is provided on at least two of the tails. Each retention feature includes a portion of the tail extending straight from the one side to form a first beam having a centerline extending normal to and through the printed circuit board. The portion of the tail is then bent in a first direction normal to the first beam to form a second beam which is substantially parallel with the first major surface of the board, and is then bent in a direction away from the one side of the connector body to form a third beam substantially normal to the second beam. The third beam being generally parallel with the first beam and terminating in a free end. The third beam includes a first bent portion extending in a direction away from the one side of the body and toward the extended centerline of the first beam to an apex. A second portion extends from the apex in a direction away from both the one side and the extended centerline to a terminal point adjacent the free end. This is arranged so that the apex is urged against one side of the through hole and another portion of the third beam is urged against the second corner of the opposite side of the through hole.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:-

FIGURE 1 is an isometric view showing a plug connector in exploded parts format;
FIGURE 2 is a view similar to that of FIGURE 1 showing a receptacle connector having retention features in accordance with the teachings of the present embodiment;
FIGURE 3 is a cross-sectional view of the connectors of FIGURES 1 and 2 shown assembled; and
FIGURES 4, 5, and 6 are cross-sectional views of the receptacle connector of FIGURE 2 showing the connector in various stages of assembly to the printed circuit board.

There is shown in FIGURE 1 a plug connector 8 composed of an insulating connector housing 10 having a main body portion 12, side shrouds 14, and a side 16 for mounting against a surface of a printed circuit board. Two parallel rows of cavities 18 are formed along the length of the housing 10 for receiving male signal contacts 20 each of which has a contacting portion 22 for electrically contacting a receptacle contact and a post
or solder tail portion 24 extending from the side 16 for inserting into a plated through hole in the printed circuit board. The housing 10 includes several openings 26 for receiving posts or solder tails 28 of a ground bus bar 30, the tails also extending from the side 16 for inserting into holes in the printed circuit board. The plug connector 8 is arranged to mate with a receptacle connector 40, shown in Figure 2, having an insulating connector housing 42. A plurality of signal receptacle contacts 44 are arranged in two parallel rows of cavities 46 which correspond to and are in alignment with the cavities 18 of the plug connector 8. The receptacle connector 40 includes a receptacle bus bar 48 composed of two opposing halves 50 and 52 each of which has a plurality of solder tails 54. The bus bar halves 50 and 52 are arranged in slots 56 disposed in the connector housing 42 so that the solder tails 54 extend out of one side 60 of the housing for insertion into plated through holes 58 disposed in a printed circuit board 59. Additionally, each of the signal receptacle contacts 44 includes a post or solder tail 45 that extends out of the side 60 for insertion into holes 62 and 64 disposed in the printed circuit board 59. The printed circuit board 59 includes first and second major surfaces 61 and 63. The through holes 62 intersect these major surfaces at upper and lower corners 65 and 67 respectively as seen in Figure 2. For a more detailed description of the plug and receptacle connectors 8 and 40 please refer to US-A-4 762 500.

There is shown in Figure 3, in cross section, the connectors 8 and 40 in mating engagement with the solder tails 45 inserted into position within the plated through holes 62 in the printed circuit board 59. The connector housing 42 includes standoffs 69 that engage the first major surface 61 of the printed circuit board 59 and maintains the side 60 substantially parallel with the major surface 65. The solder tails are soldered in place within the holes, however, the solder has been omitted from Figure 3 for clarity.

The receptacle connector 40 is shown in Figure 4 prior to insertion of the solder tails 45 fully into the holes 62. Note that the solder tails 45 and 54 are just entering their respective holes 62 and 58 but there is no mutual contact and the solder tails 45 are in their free form position. As best seen in Figure 4, the signal contact 44 includes a portion of the tail 45 that extends straight from the side 60 of the connector housing 42 and forms a first beam 70 which has a centerline 72 that extends downwardly through the printed circuit board 59, substantially normal thereto. The tail 45 then bends in a first direction normal to the first beam and away from the tails 54 of the ground bus 48 thereby forming a second beam 74. This second beam 74 is substantially parallel to the major surface 65. The tail 45 then bends in a direction away from the side 60 to form a third beam 76 which is substantially normal to the second beam and is generally parallel to the first beam and terminates in a free end 78.

The third beam 76 includes a first bent portion 80 extending in a direction away from the side 60 and to-ward the extended centerline 72 to an apex 82. A second bent portion 84 extends from the apex 82 in a direction away from both the side 60 and the extended centerline 72 to a terminal point 86 adjacent the free end 78. A stiffener rib 88 may be optionally formed in a portion of the third beam 76, as shown in Figure 4, for a purpose that will be described below. The first and second bent portions 80 and 84 and the apex 82 form a dent or kink in the third beam 76 which projects outwardly for a distance greater than the diameter of the hole 62 so that when the third beam is inserted into the hole 62, the first and second beams and the bent portions 80, 84, apex 82, and the straight portions of the third beam must deform and straighten a slight amount. This is shown in Figure 5 where the solder tails 45 and 54 have been inserted further into their respective holes 62 and 58. During this further insertion the second bent portion 84 engages the upper corner 65 of one side of the hole causing the apex 82 to cam away from the centerline 72 so that the apex can enter the hole 62. This urges the free end 78 against the wall of the opposite side of the hole causing the kink to straighten somewhat to conform to the smaller size of the hole. Additionally, the angle A at the junction of the second and third beams becomes slightly larger as well. This straightening, however, is well within the elastic limits of the tail 45. As insertion continues, the apex 82 rides down the wall of the hole until the free end 78 is substantially below the second major surface 63 and the bent member 84 engages the lower corner 67 of the hole, as best seen in Figure 6. Because the kink was elastically deformed while passing through the hole 62, there is a substantial force urging the bent portion 84 and free end 78 to pivot counterclockwise about the apex 82. Therefore, as the free end 78 emerges below the surface 63, the lower corner 67 cams along the angled surface of the bent portion 84 causing a substantial downward force on the tail 76 which, in turn, causes the connector housing 42 to snap into place against the first major surface 61. Tolerance buildup of the various parts of the connector 40 and printed circuit board 59 may preclude the lower corner 67 from camming along the free end 78 and onto the bent portion 84. In such a case the standoffs 69 are in firm engagement with the first major surface 61 while the lower corner 67 is still in contact with the free end 78. Even in this case there is a substantial downward force imposed on the tail 76 causing the connector housing to snap into place.

With the connector 40 in position against the surface 61 of the board 59, as shown in Figure 6, the angle A between the second and third beams is slightly greater than that shown in Figure 5. All of the deforming and flexing of the first, second, and third beams occurs within their respective elastic limits so that there is no substantial permanent deformation. In the event that the connector 40 is lifted slightly from the board 59, the angle A will tend to become even larger because the second beam will try to pivot at its junction with both the first and
third beams so that the third beam tends to further pivot counterclockwise about the apex 82 thereby causing the bent portion 84 to press more securely against the lower corner 67 thereby resisting further lifting of the connector. If it is desired to remove the connector 40, prior to soldering, the board 59 is placed on a flat, hard surface with the free ends 78 pointing down and in contact with the hard surface. The board 59 is then firmly pressed toward the hard surface thereby causing the free ends to move upwardly into the holes 62 until the apex 82 of each tail emerges from its hole 62. By way of example, the solder tail 78, in the present embodiment, is made of beryllium copper or some other suitable spring material, and is of substantially rectangular cross section having dimensions of about 0.018 cm by about 0.046 cm (about 0.007 inch by about 0.018 inch). Because the 0.018 cm (0.007 inch) dimension is relatively thin and flexible, in the case of beryllium copper, the stiffener rib 88 is formed in the third beam, as shown in the figures, for the purpose of increasing the force which urges the second bent portion 84 against the lower corner 67.

It will be understood that the kink comprising the first and second bent portions 80 and 84, the apex 82, and the optional stiffener 88 are formed in only selected ones of the solder tails 45. The actual number of solder tails selected to receive kinks should correspond to the amount of retention force or connector hold down force desired in each particular case. In the present example of a 100 pin microstrip connector, three such solder tails were selected for kinks at the two ends of each row resulting in 12 solder tails having kinks. While the solder tails 28 of the plug connector 8 are shown without kinks, such kinks could be advantageously employed there in accordance with the teachings of the present disclosure.

An important advantage of the present invention is that the solder tails of the connector may be inserted into the holes of a printed circuit board and the kinks formed in the tails will cause the connector to snap into place against the surface of the board. This giving a positive indication that the parts are properly mated. Additionally, the unique structure of the kink tends to resist inadvertent removal of the connector from the printed circuit board prior to soldering while permitting deliberate removal when desired without destroying the parts. Another important advantage is that retention forces are attainable that are much higher than those of similar prior art retention devices.

Claims

1. The combination of an electrical connector (8,40) of the type comprising a connector body (12) and a plurality of posts (20) each of which has a tail (24) extending out of one side of the connector body (12) for mounting on a printed circuit board (59), and a printed circuit boards (59) comprising first and second spaced, parallel major surfaces (61,63) and a plurality of through holes (64) extending therebetween and intersecting said first surface (61) at a first corner and said second surface at a second corner where said one side of the connector body (60) is substantially parallel to and in engagement with said first major surface (61) of said board, at least one pair of tails (45) being adapted to be received in a complementary pair of said through holes (64), where said tails (45) are formed of an electrically conductive material, said tails (45) exhibiting plural beams (70,74,80,84,78) where a portion of each tail extends straight from said one side thereby forming a first beam (70) having a centerline extending normal to and through said printed circuit board, said portion of said tail (24) thereafter being bent in a first direction normal to said first beam thereby forming a second beam (74) which is substantially parallel to said first major surface of said board and thereafter being bent in a direction away from said one side thereby forming a third beam (76) substantially normal to said second beam and terminating in a free end characterized in that said conductive material comprises a hardened spring metal having a predetermined elastic limit and the end of each of the tails (45) of said pair of tails (45) is configured to provide a retention feature, and in that said third beam (76) includes a first bent portion (80) extending in a direction away from said one side and toward the extended centerline of said first beam to an apex (82), and a second bent portion (84) extending from said apex (82) in a direction away from both said one side and said extended centerline to a terminal point adjacent said free end (78) so that said apex (82) is urged elastically against one side of said through hole and another portion of said beam is urged elastically against said second corner of an opposite side of said through hole, whereby, as the third beam (76) is caused to enter its corresponding through hole (62) the said apex (82) formed by said first and second bent portions (80,84) is elastically deformed by an amount below the said elastic limit, said beams (70,74,80,84,78) being so relatively dimensioned that said bent portions tighten their grip on the circuit board (59) upon the application of a lifting force to the connector (8,40).

2. The combination according to claim 1, characterized in that said first, second, and third beam (70,74,76) include spring properties which permit their deflection during insertion of the tail into the respective through hole (62) without undergoing a substantial deformation.

3. The combination according to claim 1, characterized in that said another portion of said third beam is said second portion so that said free
end (78) extends beyond said second surface.

4. The combination according to claim 2, characterized in that said first and second bent portions (50, 84) form an angle with said apex (82) such that when said tail (45) is inserted into its respective said through hole said third beam (76) deflects so that said angle is larger and a part of said tail enters into holding engagement with said second corner.

5. The combination according to claim 4, characterized in that said part of said tail that enters into holding engagement is said second bent portion (84).

6. The combination according to claim 4, characterized in that said first and second beams (80, 84) form an angle that becomes greater and thereby causes said third beam (76) to tend to pivot about said apex (82) and to further urge said part of said tail into holding engagement with said corner.

7. The combination according to claim 5, characterized in that said third beam (76) includes a stiffening rib (66) formed along a portion of its length.

8. The combination according to claim 7, characterized in that said spring metal is half hard beryllium copper.

Patentansprüche

1. Kombination eines elektrischen Verbinders (6, 40), mit einem Verbindekörper (12) und einer Vielzahl von Trägern (20), von denen jeder ein Ende (24) aufweist, das sich aus einer Seite des Verbindekörpers (12) zur Befestigung auf einer gedruckten Leiterplatte (59) erstreckt, und mit einer gedruckten Leiterplatte (59) mit einer ersten und einer zweiten, beobachteten parallelen Hauptfläche (61, 63) und einer Vielzahl von Durchgangslochern (64), die sich dazwischen erstrecken und die erste Fläche (61) an einer ersten Ecke und die zweite Fläche an einer zweiten Ecke schneidet, wobei die eine Seite des Verbindekörpers (60) im wesentlichen parallel und im Eingriff mit der ersten Hauptfläche (61) der Leiterplatte ist, wobei wenigstens ein Paar Enden (45) dafür eingerichtet sind, in einem komplementären Paar der Durchgangslocher (64) Aufnahme zu finden, wobei die Enden (45) aus einem elektrisch leitfähigen Material geformt sind, wobei die Enden (45) mehrere Stäbe (70, 74, 80, 84, 78) aufweisen, wobei sich jeweils ein Abschnitt jedes Endes gerade von der einen Seite erstreckt, wodurch ein erster Stab (70) gebildet wird, der eine Mittellinie hat, die sich normal zur gedruckten Leiterplatte und durch diese hindurch erstreckt, wobei der Abschnitt des Endes (24) danach in eine erste Richtung normal zum ersten Stab gebogen ist, wodurch ein zweiter Stab (74) gebildet wird, der im wesentlichen parallel zur ersten Hauptfläche der Platte verläuft und danach in eine Richtung weg von der einen Seite gebogen ist, wodurch ein dritter Stab (76) gebildet wird, der im wesentlichen normal zum zweiten Stab verläuft und in einem freien Ende aufhört, dadurch gekennzeichnet, daß das leitfähige Material ein gehärtetes Fademetall enthält, das eine vorbestimmte Elastizitätsgrenze aufweist und der Abschluß jedes der Enden (45) des Paares von Enden (45) ausgebildet ist, um eine Rückhaltevorrichtung zu bilden, und daß der dritte Stab (76) einen ersten gebogenen Abschnitt (80) aufweist, der sich in einer Richtung weg von der einen Seite und auf die hervorragende Mittellinie des ersten Stabes bis zu einem Scheitel (82) erstreckt, und daß ein zweiter gebogener Abschnitt (84), der sich von dem Scheitel (82) in einer Richtung weg von der einen Seite und auch von der hervorragenden Mittellinie zu einem Anschlußpunkt erstreckt, der in der Nähe des freien Endes (78) liegt, so daß der genannte Scheitel (82) elastisch gegen eine Seite des Durchgangsloches gedrängt wird und ein weiterer Abschnitt des Stabes elastisch gegen die zweite Ecke einer gegenüberliegenden Seite des Durchgangsloches gedrängt wird, wodurch, wenn der dritte Stab (76) veranlaßt wird, in sein entsprechenendes Durchgangsloch (62) hineinzugehen, der Scheitel (82), der von dem ersten und dem zweiten gebogenen Abschnitt (60, 84) gebildet wird, um einen Betrag unterhalb der Elastizitätsgrenze elastisch verformt wird, wobei die Stäbe (70, 74, 80, 84, 78) im Verhältnis so dimensioniert sind, daß die gebogenen Abschnitte ihren Griff auf der Leiterplatte (59) verstärken, wenn eine Abnehmekraft auf den Verbinde (6, 40) aufgebracht wird.

2. Kombination nach Anspruch 1, dadurch gekennzeichnet, daß erste, zweite und dritte Stäbe (70, 74, 76) Federeigenschaften aufweisen, die deren Abbiegen während des Einsatzes des Endes in das entsprechende Durchgangsloch (62) erlauben, ohne eine wesentliche Verformung zu erfahren.

3. Kombination nach Anspruch 1, dadurch gekennzeichnet, daß der weitere Abschnitt des dritten Stabes der zweite Abschnitt ist, so daß das freie Ende (78) sich über die zweite Oberfläche hinaus erstreckt.

4. Kombination nach Anspruch 2, dadurch gekennzeichnet, daß der erste und zweite gebogene Abschnitt (80, 84) mit dem Scheitel (82) einen Winkel bilden, derart, daß, wenn das Ende (45) in sein entsprechendes Durchgangsloch eingesetzt wird, der
dritte Stab (76) sich biegt, so daß der Winkel größer ist und ein Teil des Endes in Halteeingriff mit der zweiten Ecke kommt.

5. Kombination nach Anspruch 4, dadurch gekennzeichnet, daß der Teil des Endes, der in Halteeingriff kommt, der zweite gebogene Abschnitt (84) ist.

6. Kombination nach Anspruch 4, dadurch gekennzeichnet, daß der erste und der zweite Stab (50, 84) einen Winkel bilden, der größer wird und dadurch bewirkt, daß der dritte Stab (76) dazu tendiert, um den Scheitel (82) zu schwenken und um außerdem den Teil des Endes in Halteeingriff mit der Ecke zu drängen.

7. Kombination nach Anspruch 5, dadurch gekennzeichnet, daß der dritte Stab (76) eine Versteifungsrinne (86) aufweist, die entlang eines Abschnitts seiner Länge geformt ist.


Revendications

1. Combinaison d'un connecteur électrique (8, 40) du type comportant un corps (12) de connecteur et plusieurs brochages (20) ayant chacune une queue (24) s'étendant vers l'extérieur d'un premier côté du corps (12) du connecteur pour un montage sur une plaquette (59) à circuits imprimés, et une plaquette (59) à circuits imprimés présentant des première et seconde surfaces principales parallèles et espacées (61, 63) et plusieurs trous traversants (64) s'étendant entre elles et intersectant ladite première surface (61) à un premier angle et ladite seconde surface à un second angle, ledit premier côté du corps (60) du connecteur étant sensiblement parallèle à ladite première surface principale (61) de ladite plaquette et en contact avec elle, au moins une paire de queues (45) étant destinées à être reçues dans une paire complémentaire desdits trous traversants (64), lesdites queues (45) étant formées d'une matière électriquement conductrice, lesdites queues (45) présentant plusieurs poutres (70, 74, 80, 84, 76) où une partie de chaque queue s'étend en ligne droite depuis ledit premier côté, formant ainsi une première poutre (70) ayant un axe central s'étendant perpendiculairement à ladite plaquette à circuits imprimés et la traversant, ladite partie de ladite queue (24) étant ensuite pliée dans une première direction perpendiculaire à ladite première poutre, formant ainsi une deuxième poutre (74) qui est sensiblement parallèle à ladite première surface principale de ladite plaquette et étant ensuite pliée dans une direction s'éloignant dudit premier côté, formant ainsi une troisième poutre (76) sensiblement perpendiculaire à ladite deuxième poutre et se terminant par une extrémité libre, caractérisée en ce que ladite matière conductrice comprend un métal à ressort durci ayant une limite élastique prédéterminée et l'extrémité de chacune des queues (45) de ladite paire de queues (45) est configurée de façon à présenter une configuration de retenue, et en ce que ladite troisième poutre (76) comprend une première partie pliée (80) s'étendant dans une direction s'éloignant dudit premier côté et vers l'axe central prolongé de ladite première poutre jusqu'à un sommet (82), et une seconde partie pliée (84) s'étendant depuis ledit sommet (82) dans une direction s'éloignant à la fois dudit premier côté et dudit axe central prolongé jusqu'à un point terminal adjacent à ladite extrémité libre (78) afin que ledit sommet (82) soit sollicité élastiquement contre un premier côté dudit trou traversant et qu'une autre partie de ladite poutre soit sollicitée élastiquement contre ledit second angle d'un côté opposé dudit trou traversant, grâce à quoi, lorsque la troisième poutre (76) est amenée à entrer dans son trou traversant correspondant (62), ledit sommet (82) formé par lesdites première et seconde parties pliées (80, 84) est déformé élastiquement d'une quantité inférieure à ladite limite élastique, lesdites poutres (70, 74, 80, 84, 76) étant de dimensions relatives telles que lesdites parties pliées serrent leur prise sur la plaquette (59) à circuits lors de l'application d'une force de soulèvement au connecteur (8, 40).

2. Combinaison selon la revendication 1, caractérisée en ce que lesdites première, deuxième et troisième poutres (70, 74, 76) présentent des propriétés de ressorts qui permettent leur flexion pendant une insertion de la queue dans le trou traversant respectif (62) sans subir une déformation substantielle.

3. Combinaison selon la revendication 1, caractérisée en ce que ladite autre partie de ladite troisième poutre est ladite seconde partie afin que ladite extrémité libre (76) s'étende au-delà de ladite seconde surface.

4. Combinaison selon la revendication 2, caractérisée en ce que lesdites premières et seconde parties pliées (80, 84) forment un angle avec ledit sommet (82) tel que, lorsque ladite queue (45) est insérée dans son trou traversant respectif, ladite troisième poutre (76) fléchisse afin que ledit angle soit plus grand et qu'une portion de ladite queue entre en prise de maintien avec ledit second angle.

5. Combinaison selon la revendication 4, caractérisée en ce que ladite portion de ladite queue qui entre...
en prise de maintien est ladite seconde partie pliée (84).

6. Combinaison selon la revendication 4, caractérisée en ce que lesdites première et deuxième poutres (80, 84) forment un angle qui augmente et amène ainsi ladite troisième poutre (76) à tendre à pivoter autour dudit sommet (82) et à soliciter davantage ladite portion de ladite queue en prise de maintien avec ledit angle.

7. Combinaison selon la revendication 5, caractérisée en ce que ladite troisième poutre (76) comprend une nervure (86) de raidissement formée le long d’une partie de sa longueur.

8. Combinaison selon la revendication 7, caractérisée en ce que ledit métal à ressort est du cuivre au béryllium demi-dur.