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**IMPROVED SOLDER TAIL AND ELECTRIC
CONNECTOR INCORPORATING SAME**

Background of the Invention

The present invention relates generally to a terminal assembly for an electric connector, and more particularly to a terminal having an improved solder tail portion which facilitates the attaching of the terminals of a connector to a printed circuit board, and which improves the quality control of mounting connectors to circuit boards.

As is well known, electric connectors are used to connect different electronic devices to printed circuit boards in various electrical and electronic apparatus. Such electric connectors usually include a plurality of terminals arranged at predetermined intervals and fixed to a connector housing. Each terminal may have its tail portion extend outwardly from the housing so that it may be soldered to an associated hole in a circuit board.

In the manufacture of such electric connectors, a plurality of these terminals are typically inserted into corresponding holes of the connector housing or are embedded in a connector housing mold and the connector housing formed by injection molding the housing around the terminals. The connector housing often has positioning pegs disposed at its opposite ends, thereby

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permitting the correct positioning of the connector relative to an associated printed circuit board.

In use, these connectors may be attached to associated circuit boards by positioning the connector on the circuit board with the aid of their connector positioning pegs and by inserting the extending solder tails of the terminals into engagement holes in the circuit board. The terminal solder tails are then soldered to the circuit board. The effectiveness of attachment of the connector to the circuit board depends on the exactness with which all terminals are positioned with respect to the positioning pegs of the housing and the engagement holes. Even if the connector housing is placed onto the circuit board in a correct position with the aid of its positioning pegs, some of the solder tails may not necessarily be aligned with the corresponding engagement holes of the circuit board and, accordingly, may catch against or interfere with the edges of the engagement holes when the connector housing is pushed against the printed circuit board.

This interference may not only lead to bending or other damage to the solder tails, but also may prevent the effective attachment of the electric connector to the circuit board. These disadvantages increase with the reduction of any alignment tolerance for mispositioning each terminal relative to the circuit board engagement hole. Accordingly, difficulty in controlling the quality



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of these connectors increases with the decrease in tolerance for misalignment for each terminal relative to the corresponding receiving hole in the circuit board.

5 **Summary of the Invention**

10 The present invention provides a connector housing and a group of terminals arranged at regular intervals in the housing and laterally extending therefrom, the terminals being formed from a terminal assembly, the terminal assembly including a series of spaced-apart terminals integrally connected to a lateral carrier strip and interconnected thereto at a joint portion extending from a terminal body portion to the carrier strip, the joint portion having two generally parallel edges, one edge extending inwardly from the terminal body portion toward the centerline of the joint portion, each terminal of the group of terminals being separated from the lateral carrier strip after being fixed to the housing by cutting the joint portion diagonally to provide a tapered end to the terminal.

20 A connector of the present invention also comprises a connector housing and a group of terminals laterally arranged at regular intervals and fixed to the housing, each end of the terminal having a solder tail portion, the solder tail portion having a first longitudinal edge which extends close to or in alignment with the centerline of the soldering portion inward from a

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body portion of the terminal, the solder tail portion having a second edge which intersects the first edge and which extends diagonally across the centerline of the solder tail portion at an acute angle, thereby forming a tapered, or beveled end, to the solder tail portion.

The first edge of the solder tail portion near the tapered end is defined at the time of stamping, and therefore provides a primary reference or alignment line. The acute angle of the tapered end can be used as a reference point in optically aligning the connector terminals with their opposing circuit board engagement holes. The tapered end includes part of a reentrant portion located near the centerline, thereby leaving a relatively large allowance on either side of the terminal solder tail portion such that the terminal may be more easily located in a permissible alignment position relative to the circuit board engagement hole for insertion.

These and other objects, features and advantages of the present invention will be apparent through a reading of the following detailed description, taken in conjunction with accompanying drawings, wherein like reference numerals refer to like parts.

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Brief Description of the Drawings

In the course of the following detailed description, reference will be made to the attached drawings in which:

5 FIG. 1 is an elevational view of a connector utilizing a terminal assembly constructed in accordance with the principles of the present invention;

FIG. 2 is a plan of the connector of FIG. 1;

10 FIG. 3 is an elevational view of an end of the connector of FIG. 1;

FIG. 4 is a plan view of a portion of a terminal assembly constructed in accordance with the principles of the present invention illustrating the portion wherein the terminal is formed as part of a carrier strip;

15 FIG. 5 is a plan view of the tail end of the terminal of FIG. 4 after cutting along line A-A of FIG. 4;

20 FIG. 6 shows the manner in which the connector of FIG. 1 is mounted to an associated printed circuit board;

FIG. 7 is a plan view of a portion of a conventional terminal wherein the portion is part of a carrier strip;

25 FIG. 8 is a plan view of the tail end of the terminal of FIG. 7 after cutting along line F-F of FIG. 7;



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FIG. 9 shows the manner in which a connector using the terminals of FIG. 8 is mounted to a printed circuit board;

5 FIG. 10 is a plan view of a portion of another conventional terminal wherein the portion is part of a carrier strip;

FIG. 11 is a plan view of the tail end of the terminal of FIG. 10 after cutting along line A-A of FIG. 10;

10 FIG. 12 shows the manner in which a connector using the terminals of FIG. 11 is mounted to a printed circuit board;

15 FIG. 13 is a plan view of a portion of still another conventional terminal wherein the portion is part of a carrier strip;

FIG. 14 is a plan view of the tail end of the terminal of FIG. 13 after cutting along line U-U of FIG. 13; and

20 FIG. 15 shows the manner in which a connector using the terminals of FIG. 14 is mounted to a printed circuit board.



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Detailed Description of the Preferred Embodiments

The benefits and advantages of the structure of the present invention will become more apparent after an examination of the deficiencies and disadvantages of the prior art.

FIG. 7 illustrates a tail portion of a conventional connector terminal 21 which is secured in a connector housing (not shown).

The terminals 21 are made in a conventional manner from an elongated metal sheet or strip by stamping to define a continuous arrangement of terminals integrally connected to the carrier strip 33. As seen in FIG. 7, the terminal 21 includes a solder tail 25 which extends out from the connector housing. This solder tail 25 includes the body portion 26 and a reduced width tip which is inserted into the circuit board engagement holes H.

The terminal body portion 26 is relatively wide and has two opposing, generally parallel edges 51, 52 which converge or reduce in width down to that of the joint portion 24. This reduction is defined by the opposing angled edges 34, 25 which extend inwardly from the body portion edges 51, 52 until they attain a predetermined width for the joint portion 24 as represented by opposing parallel edges 30.

The joint portion 24 then diverges outwardly and increases in its width as illustrated at the bottom

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of FIG. 7 to form another wider section having parallel
opposing edges 27, 28 of approximately the same width as
the body portion 26. It can be understood that the
profile of the joint portion 24 includes, in effect, a
notched or reentrant area 31 of the terminals.

The terminal assembly, i.e., the carrier strip
33 and its extending terminals 21 are attached to the
connector housing by inserting the terminals 21
(typically contact and body portion first) into corre-
sponding cavities of the connector housing. Then, by
cutting all of the terminals 21 from the carrier strip 33
along line F-F, the terminals 21 are separated from the
carrier strip so that they attain the reduced end tab
profile as indicated at E in FIG. 8. Alternatively, the
terminals may be separated from the carrier strip 33 and
subsequently inserted into the connector housing.

In the mounting of the connector onto a circuit
board, an optical measurement is often made to determine
if the terminals 21 are properly spaced relative to the
housing at correct regular intervals as indicated at "P".
However, conventional terminals 21 of the type
illustrated in FIGS. 7-9 provide no portions or surfaces
which may be used as a standard to permit optical
measurements. Therefore, the required quality control
for ensuring alignment of the terminal solder tail
portions with the circuit board engagement holes is
difficult. As seen best in FIG. 9, the neck portion 24

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In order to facilitate optical measurement of the intervals P of the terminals 21 for quality control and to facilitate the insertion of terminals 21 into a circuit board, there has been proposed a third terminal 21" with a solder tail 26" having a rounded terminal end as shown in FIG. 13. It has an extended body portion 25" which is integrally formed with an elongated, transversely extending carrier strip 33". The body portion 25" has parallel edges 27", 28" which extend for the length of the body portion 25". The solder tail portion 26" is formed into a rounded shape along line U-U in FIG. 13 when it is separated from the carrier strip 33" by a cutting punch.

This rounded end is symmetrical around a centerline 29 and it provides a reference point for optical measurement to determine the spacing of the solder tails with respect to the circuit board engagement holes. It also provides a relatively large alignment tolerance "d" or "d'" on either side of the solder tail centerline as indicated in FIG. 15. However, the rounded cut illustrated in FIGS. 14 & 15 is more expensive and difficult than a straight or diagonal cut as illustrated in FIGS. 4, 5, 10 & 11.

Furthermore, incorrect severing, such as that which may occur if the cutting punch is even slightly misaligned with the terminals may lead to an appreciable deviation U' relative to the centerline 29 (FIG. 14)

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resulting in the terminals being arranged out of order with their reference points for optical measurement. This makes the quality control extremely difficult.

5 Referring now to FIGS. 1-3, an electrical connector utilizing terminals constructed in accordance with the principles of the present invention is illustrated generally at 60 and comprises an elongated connector housing 3 having a group 2 of terminals 1 fixed to the housing 3 and extending therefrom at a lateral spacing
10 "P" between centerlines of adjoining terminals 1. The top portion 17 of the connector housing 3 has an longitudinal channel or insertion slot 17a which is intended to accommodate an additional electric connector part, plug or secondary circuit card. Contact portions
15 65 of the terminals extend into this channel 17a.

The terminals include tail portions 18 which extend out of the connector through the bottom portion of the housing 3. These tail portions 18 serve as solder tails which are eventually soldered to an associated
20 printed circuit board B. (FIG. 6.) The housing 3 may also include a pair of positioning pegs 19 and/or boardlocks 19a at its opposite ends to facilitate the positioning of the electric connector relative to the printed circuit board B.

25 As seen in FIGS. 4 and 5, the terminals 1 are formed as part of an overall terminal assembly 50 which is initially stamped and formed from a strip of metal to

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provide a series of interconnected terminals integrally formed with a carrier strip 13 as is well known in the art. As illustrated in FIG. 4, the terminal 1 has a relatively wide body portion 61 which is integral with a reduced-width joint or neck portion 4, which in turn connects the terminal body portion 61 to the carrier strip 13. The terminal body portion 61 has two opposing, generally parallel edges 7, 8 which define a predetermined width of the body portion 61. The joint portion 4 is located adjacent the body portion 61 (shown below it in FIG. 4) and also has two longitudinal sides, or edges 11 and 62 which extend generally parallel to each other.

A plurality of such terminals 1 are integrally formed with the carrier strip 13, such as by stamping and forming the entire assembly from a single strip of metal. After being fixed to the connector housing 3, the terminals may be separated from the carrier strip 13 by cutting through the joint portions 4 at a diagonal (along line A-A of FIG. 4) to provide an acute angle at "E". This cutting forms a tapered end portion 6 of the soldering tail.

Focusing specifically on the reduced-width portion 5 of the terminal 1, it can be seen in FIGS. 5 & 6 that this portion has a first side, or edge 11, which is located inwardly of a corresponding edge 7 of the terminal body portion 61. This edge 11 is displaced or



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offset from the body portion first edge 7 toward the centerline 9 of the joint portion 4 and thereby substantially defines a notch, or reentrant portion 10, of the terminal 1. The reentrant portion 10 is formed on each terminal 1 during stamping of the elongated metal strip and has a configuration which is relatively easy to form upon a stamping die or cutting punch so that all of the terminals 1 integrally formed with the carrier 13 strip will have their reentrant sections 10 spaced apart from each other at regular intervals.

The opposing edge 62 of the reduced width portion 4 extends evenly from the opposite edge 8 of the terminal body portion 61 so that the reduction in width of the portion 4 is accomplished by the reentrant portion 10. However, it is contemplated that an additional reentrant portion may be provided in the opposing edge 62 if necessary. In forming the final solder tail, the reduced width portion 4 is cut along the diagonal line A-A illustrated which extends downwardly from the area where the terminal body portion 8 joins with the reduced width joint portion 4 to the reentrant portion 10. This cut is made at a diagonal and traverses the centerline 9 of the terminal 1. (FIG. 5.)

This diagonal cut defines an angled edge or guide surface 12 which forms a tapered end E at the end of the terminal 1 and which serves as a "lead-in" portion for the terminal as explained below. Preferably, this



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5 tapered end of the terminal forms an acute angle. The lead-in portion 5 has a reduced width as compared to the terminal body portion 61 and presents the angled edge or surface 12 in opposition to the circuit board engagement hole.

10 The terminal solder tails 18 are spaced apart at regular intervals from each other when all of the terminals 1 are diagonally cut and separated from the carrier strip 13. Once cut, all of the terminals 1 are consequently arranged with the intersecting straight and slanted sides 11, 12 of the tapered end 5 in a spaced-apart order wherein the same distances exist between straight and slant sides of adjacent terminals. This is advantageous when utilizing optical means for determining
15 whether all of the terminals 1 are arranged at regular intervals as desired when automating, the quality control of insertion of the terminal portions of the connectors into circuit boards.

20 As shown in FIG. 6, while attaching an electric connector to a circuit board B utilizing the terminals 1 of the present invention, the positioning pegs 19 of the connector 3 are inserted in the positioning holes H' of the circuit board B in a manner which permits the terminal tail portions 18 to enter the holes H of the
25 printed circuit board B simultaneously. The tapered ends 5 of the terminals 1 extend through the board engagement holes and may project partially beyond the bottom surface

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of the board. Solder is applied to the solder tails and circuit board to affect a reliable electric attachment.

As described above, the reentrant portion may be easily formed in the terminals by stamping in a manner such that the reentrant portions of adjacent terminals are spaced apart from each other at regular intervals. The reentrant portion defines an interior edge 11 of the joint portion 4 which lies inwardly of the corresponding terminal body portion edge 7. The terminals 1 are defined into their final shape by cutting the joint portions 4 diagonally along line A-A to form a slanted, or angled edge 12 which extends inwardly across the terminal centerline 9 of the terminal to intersect with the first edge 11. Preferably, the angled edge 12 is formed at an acute angle to present the stepped, or sawtooth configuration of FIG. 5. The angled edged 12 of the tip of the solder tail extends generally opposite that of the angled edge or surface 14 of the reentrant portion 10 of the terminal so that if imaginary lines are extended along those two surfaces 12, 14, they will intersect. It will be appreciated that the two inclined edges 12, 14 cooperate to provides a dual alignment or positioning allowance d and d' (FIG. 6) on opposite sides of the tip of the solder tail 18. This allowance is located on both sides of the tail portion centerline and improves the mounting of connectors using such terminal assembly to circuit boards. Importantly, these two

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angled surfaces 12, 14 extend toward the centerline 9 of the tail portion at terminal 1 and of the circuit board engagement hole and thereby provide angled lead-in or pilot surfaces which may engage each edge of the holes during insertion, if necessary.

In the particular embodiment of FIG. 5, the tapered end 5 of the solder tail is described as having a straight edge 11 proximate to the centerline 9 rather than in alignment therewith. This off-center arrangement has the effect of increasing the resistance of terminal to deformation or other damage during handling and processing.

As may be understood from the above, an electric connector terminal assembly according to the present invention comprises a series of terminals each having a solder tail with a lead-in portion defined by an inward edge close to or in alignment with the imaginary centerline on one side and a slanted edge side diagonally traversing the centerline on the other side, thus forming an acute angle point in the vicinity of the centerline to provide comparable allowances on the opposite sides of the terminal centerline to assist in mounting the terminal assembly to a printed circuit board. The acute angle point is advantageous to the optical measurement of terminal intervals for quality control.

Accordingly, it will be appreciated that the embodiments of the present invention have discussed

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herein are merely illustrative of a few applications of the principles of the invention. Numerous modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

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5 1. A terminal (1) for use in an electrical
connector of the type which is mounted upon a circuit
board (B), the connector having a housing (3) with a
plurality of terminal receiving areas therein, said
connector having a plurality of terminals in said
terminal receiving areas, contact portions (65) of the
10 terminals being held within said housing while tail
portions (18) of said terminals extend out of said
housing, said tail portions being configured to be
received in corresponding engagement holes (H) of the
circuit board, each said tail portion comprising:

15 a body portion (61) that extends out from said
connector housing when said terminal is received within
said connector housing, and a lead-in portion (5)
disposed adjacent the body portion,

20 said body portion having a first width and said
lead-in portion having a second width which is less than
said body portion first width,

25 said lead-in portion being defined by at least two
intersecting edges (11,12), a first (11) of said edges
being disposed at a reentrant portion (10) generally
adjacent the junction of said body portion and said lead-
in portion, the first edge (11) being disposed inwardly
with respect to a corresponding first edge (7) of said



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body portion and toward a longitudinal centerline (9) of
said tail portion, the lead-in portion second edge (12)
crossing said centerline of said tail portion and
intersecting said lead-in portion first edge at an acute
angle (E) to thereby define a tapered tip of said
terminal, the junction of said terminal body and lead-in
portions including an angled edge (14) which forms part
of said reentrant portion and which is disposed opposite
said lead-in portion second edge such that said lead-in
portion second edge and said angled edge present two
angled surfaces that extend toward the tail portion
centerline.

2. The terminal as defined in claim 1,
wherein said lead-in portion first edge is spaced apart
from and generally parallel to tail portion centerline.

3. The terminal as defined in claim 2,
wherein said lead-in portion first edge is generally
parallel to said tail portion centerline.

4. The terminal as defined in claim 1,
wherein said reentrant portion extends inwardly from said
body portion toward said tail portion centerline.

5. The terminal as defined in claim 1,
wherein said lead-in portion first edge is generally





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parallel to two opposing edges (7, 8) of said terminal body portion and is disposed inwardly of one of said body portion edges (7), thereby defining a misalignment tolerance.

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6. The terminal as defined in claim 5, wherein said lead-in portion first edge is spaced apart from said tail portion centerline.

10

7. The terminal as defined in claim 1, wherein said angled edge (14) is disposed at said reentrant portion such that an imaginary line drawn along said angled edge crosses said tail portion centerline.

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8. The terminal as defined in claim 5, wherein said angled edge (14) is disposed at reentrant portion such that an imaginary line drawn along said angled edge crosses said tail portion centerline.

20

9. The terminal as defined in claim 5, wherein said angled edge (14) defines part of said reentrant portion and is disposed on said terminal such that an imaginary line drawn along said angled edge crosses said tail portion centerline and intersects with said lead-in portion second edge between said lead-in portion first edge and one of said body portion edges.

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10. A connector adapted for mounting on a printed circuit board, the connector including a dielectric housing (3) having a plurality of terminal receiving areas therein, the connector housing having a plurality of electrically conductive terminals disposed within said areas, each terminal (1) having a contact portion (65) for mating with an electrically conductive portion of another circuit element and a tail portion which extends out of said housing and which is confirmed to be received in a hole on the printed circuit board, each tail portion including an angled tip (6) having a terminal tail portion misalignment tolerance associated therewith such that the angled tip has a width which is less than an opening of said circuit board hole, each tail portion further including a body portion having opposing first and second edges (7, 8), a reentrant portion (10) associated therewith and intersecting with one of said body portion opposing edges, the reentrant portion including an angled edge (14) extending toward a centerline (9) of said terminal tail portion and a connecting edge (11) intersecting said angled edge and disposed on said terminal tail portion inwardly of one of said body portion opposing edges, said reentrant portion connecting edge forming an edge of said terminal tail portion angled tip, said terminal tail portion misalignment tolerance being defined by the extent to



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which said reentrant portion extends inwardly of said body portion one edge.

11. The connector as defined in claim 10,
5 wherein said reentrant portion angled edge is disposed on said terminal tail portion such that an imaginary line drawn therealong intersects said terminal tail portion centerline and an angled surface of said terminal tail portion angled tip.

10 12. The connector as defined in claim 10, wherein said terminal tail portion angled tip forms an acute angle (E).

15 13. The connector as defined in claim 10, wherein said reentrant portion connecting edge (11) is substantially parallel to said body portion first edge (F).

20 14. The connector as defined in claim 10, wherein said terminal tail portion angled tip (6) includes an angled surface (12) extending in a direction opposite that of said reentrant portion angled surface.



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