

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
26 May 2005 (26.05.2005)

PCT

(10) International Publication Number
WO 2005/048409 A1

(51) International Patent Classification⁷: **H01R 13/24**,
H05K 7/10

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(21) International Application Number:
PCT/US2004/037235

(22) International Filing Date:
5 November 2004 (05.11.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/517,912 6 November 2003 (06.11.2003) US
60/542,892 9 February 2004 (09.02.2004) US

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
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ZW.

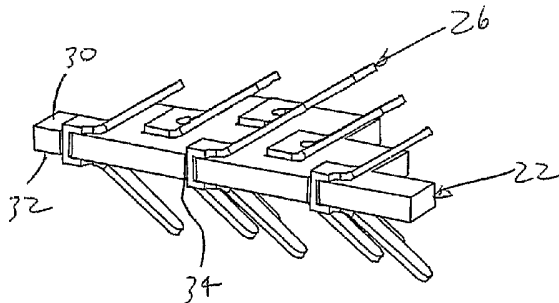
(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LU, MC, NL, PL, PT, RO, SE,
SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: LAND GRID ARRAY SOCKET CONNECTOR



(57) Abstract: A connector, which can be used in a land grid array, includes a dielectric carrier (22) and at least one conductive terminal (26) attached thereto. Each terminal is mounted through a respective aperture (34) in the carrier. Each terminal includes a connecting portion which extends through the aperture, a first beam which extends from the connecting portion and provided on a first side (30) of the carrier and a second beam extending from the connecting portion and provided on a second side (32) of the carrier. The first and second beams are angled relative to the carrier. Each terminal is crimped to the carrier thereby forming a crimped joint between the terminal (26) and the carrier (22).

LAND GRID ARRAY SOCKET CONNECTOR

Background of the Invention:

Socket connectors are commonly used in a land grid array (LGA) for use in an electronic device, such as a computer server or a router. The socket connector provides a connection between a chip package or other appropriate electronic component and a printed circuit board or other appropriate electronic component. Terminals in the socket connector provide for a secure connection to the electronic components.

As electronic devices become smaller, more and more connections for passing signals must be provided in a smaller space. There is a need for a socket connector which can provide for a high array count, while being inexpensive to manufacture. In addition, the inductance of the socket connector must be low.

Objects and Summary of the Invention:

A general object of the present invention is to provide a socket connector for a land grid array that is low cost to form and easily manufactured.

An object of the of the present invention is to provide a socket connector which has a small pitch such that a low inductance is provided.

Another object of the present invention is to provide a socket connector which has a low profile.

Yet another object of the present invention is to provide a socket connector which has terminals that can be provided in an array, as a single terminal or as a strip.

Briefly, and in accordance with the foregoing, the present invention discloses a connector which can be used in a land grid array. The connector includes a carrier and at least one terminal attached thereto. The carrier is formed of a flexible, dielectric material having first and second sides, and having at least one aperture provided therethrough. Each terminal is conductive and is mounted through a respective aperture in the carrier. Each terminal includes a connecting portion which extends through the aperture, a first beam which extends from the connecting portion and provided on the first side of the carrier and a second beam extending from the connecting portion and provided on the second side of the carrier. The first and second beams are angled relative to the carrier. Each terminal is crimped to the carrier thereby forming a crimped joint between the terminal and the carrier.

Brief Description of the Drawings:

The organization and manner of the structure and operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, wherein like
5 reference numerals identify like elements in which:

FIG. 1 is a perspective view of a first embodiment of a terminal prior to assembly to a carrier;

FIG. 2 is a perspective view of a second embodiment of a terminal prior to assembly to a carrier;

10 FIG. 3 is a side elevational view of a socket connector which incorporates features of the present invention shown with electronic components in side elevation;

FIG. 4 is a top perspective view of a first embodiment of a carrier which has one of the terminals shown in FIG. 1 attached thereto;

15 FIG. 5 is a cross-sectional view, shown in perspective, of the carrier shown in FIG. 4 which has a plurality of terminals shown in FIG. 1 attached thereto, some of the terminals being shown in cross-section;

FIG. 6 is a cross-sectional view of the carrier shown in FIG. 5 and one of the terminals shown in FIG. 1 attached thereto shown in side elevation;

20 FIG. 5a is a cross-sectional view, shown in perspective, of the carrier shown in FIG. 4 in accordance with an alternate embodiment, which has a plurality of terminals shown in FIG. 1 attached thereto, some of the terminals being shown in cross-section;

FIG. 6a is a cross-sectional view of the carrier shown in FIG. 5a and one of the terminals shown in FIG. 1 attached thereto shown in side elevation;

FIG. 7 is a top elevational view of the carrier and terminals shown in an array;

25 FIG. 8 is a perspective view of a second embodiment of a carrier which has one of the terminals shown in FIG. 1 attached thereto;

FIG. 9 is a cross-sectional view of the carrier shown in FIG. 8 and one of the terminals shown in FIG. 1 attached thereto shown in side elevation;

30 FIG. 10 is a top elevational view of an array of terminals, the terminals being formed in accordance with the embodiment shown in FIG. 1;

FIG. 11 is a top elevational view of a strip of terminals, the terminals being formed in accordance with the embodiment shown in FIG. 1;

FIG. 12 is a top elevational view of the terminals formed in accordance with the embodiment shown in FIG. 1 shown attached to the carrier;

FIG. 13 is a perspective view of an array of terminals formed in accordance with the embodiment shown in FIG. 1 attached to a carrier and surrounded by a framework;

FIG. 14 is a perspective view of an array of terminals formed in accordance with the embodiment shown in FIG. 1 attached to a carrier and including coverlays provided on opposite sides of the carrier; and

FIG. 15 is an alternate embodiment of the terminal formed in accordance with the embodiment shown in FIG. 1.

Detailed Description of the Illustrated Embodiments:

While the invention may be susceptible to embodiment in different forms, there is shown in the drawings, and herein will be described in detail, a specific embodiment with the understanding that the present disclosure is to be considered an exemplification of the principles of the invention, and is not intended to limit the invention to that as illustrated and described herein.

The present invention provides a socket connector 20 for a land grid array (LGA) for use in an electronic device, such as a computer server or a router. The socket connector 20 includes a carrier 22; 24 onto which at least one terminal 26; 28 is provided.

The carrier 22; 24 is formed of a flexible sheet of dielectric material, such as plastic or a film. A first embodiment of the carrier 22 is shown in FIGS. 4 and 5. A second embodiment of the carrier 24 is shown in FIG. 8. The first embodiment of the carrier 24 has a first side 30 and a second side 32 and includes a plurality of spaced apart apertures 34 provided therethrough in a predetermined pattern. The second embodiment of the carrier 24 has a first side 36 and a second side 38 and includes a plurality of pairs of spaced apart apertures 40a, 40b provided therethrough in a predetermined pattern. The apertures can be a variety of shapes, including generally rectangular, "U" shaped, or "H" shaped to facilitate assembly.

Each terminal 26, 28 is formed from a single, integrally formed member of a conductive material. The terminal 26, 28 may be stamped out of a sheet material and formed into its predetermined shape as shown in FIGS. 1 and 2 (i.e., the shape prior to assembly with the carrier 22; 24) by suitable means known in the art. A first embodiment of the terminal 26 is a dual beam terminal 26 and a second embodiment of the terminal 28 is a single beam terminal 28. Either terminal 26; 28 can be used with either carrier 24; 26.

Attention is invited to FIG. 1 which illustrates the dual beam terminal 26. The dual beam terminal 26 includes a first beam 42 which connects with a second beam 44 by a

connecting portion 46. The dual beam terminal 26 has a predetermined maximum width and a predetermined maximum thickness. The dual beam terminal 26 may have a uniform width and a uniform thickness. As shown in the drawings, the maximum width is defined at the connecting portion 46, but the maximum width may be defined by either beam 42, 44. As shown in the drawings, the maximum thickness is also defined at the connecting portion 46, but the maximum thickness may be defined by either beam 42, 44.

The connecting portion 46 can be generally rectangular or partially rounded and has a predetermined height, width and thickness. The connecting portion 46 defines a first end and a second, opposite end.

The first beam 42 is formed from a base 48 and a pair of fingers 50a, 50b that extend therefrom. Each finger 50a, 50b has an end fixed to the base 48 and extends therefrom such that the opposite end is free. The free end may be rounded as shown in the drawings. The fingers 50a, 50b are spaced apart from each other on the base 48 such that a slot 52 is formed between the fingers 50a, 50b. The fingers 50a, 50b are angled relative to the base 48 at a predetermined angle. As shown in the drawings, the fingers 50a, 50b are angled outwardly and upwardly from the base 48. The base 48 is generally rectangular or is partially rounded and extends substantially perpendicularly from the first end of the connecting portion 46. The base 48 and the connecting portion 48 may have the same width. The combined width of the fingers 50a, 50b and the slot 52 may be greater than (which would then define the maximum width), less than or equal to the width of the base 48 and/or the connecting portion 46. The fingers 50a, 50b are small and can be on a small pitch, for example 1mm grid.

The second beam 44 is formed from a base 54 and a pair of fingers 56a, 56b that extend therefrom. Each finger 56a, 56b has an end fixed to the base and extends therefrom such that the opposite end is free. The free end may be rounded as shown in the drawings.

The fingers 56a, 56b are spaced apart from each other on the base 54 such that a slot 58 is formed between the fingers 56a, 56b. The fingers 56a, 56b are angled relative to the base 54 at a predetermined angle. As shown in the drawings, the fingers 56a, 56b are angled outwardly and downwardly from the base 54. The base 54 is generally rectangular or partially rounded and extends substantially perpendicularly from the second end of the connecting portion 46. A generally "V" shape is formed by the first beam 42, the connecting portion 46 and the second beam 44. The base 54 and the connecting portion 46 may have the same width. The combined width of the fingers 56a, 56b and the slot 58 may be greater than (which would then define the maximum width), less than or equal to the width of the base 54

and/or the connecting portion 46. The fingers 56a, 56b are small and can be on a small pitch, for example 1mm grid.

The area of the connecting portion 46 between the first and second beams 42, 44 defines a predetermined height.

5 Attention is now invited to FIG. 2 which illustrates the single beam terminal 28. The single beam terminal 28 includes a first beam 60 which connects with a second beam 62 by a connecting portion 64. The single beam terminal 28 has a predetermined maximum width and a predetermined maximum thickness. The terminal 28 may have a uniform width and a uniform thickness along the terminal 28. As shown in the drawings, the maximum width is
10 defined at the connecting portion 64, but the maximum width may be defined by either beam 60, 62. As shown in the drawings, the maximum thickness is also defined at the connecting portion 64, but the maximum thickness may be defined by either beam 60, 62.

 The connecting portion 64 is generally rectangular or slightly rounded and has a predetermined height, width and thickness. The connecting portion 64 defines a first end and
15 a second, opposite end.

 The first beam 60 is formed from a base 66 and a finger 68 that extends therefrom. The finger 68 has an end fixed to the base 66 and extends therefrom such that the opposite end is free. The free end may be rounded as shown in the drawings. The finger 68 is provided generally at the centerpoint of the base 66. The finger 68 is angled relative to the
20 base 66 at a predetermined angle. As shown in the drawings, the finger 68 is angled outwardly and upwardly from the base 66. The base 66 is generally triangular and extends substantially perpendicularly from the first end of the connecting portion 64. The base 66 and the connecting portion 64 may have the same width. The finger 68 is small and is spaced on a small pitch, for example 1mm grid.

25 The second beam 62 is formed from a base 70 and a finger 72 that extends therefrom. The finger 72 has an end fixed to the base 70 and extends therefrom such that the opposite end is free. The free end may be rounded as shown in the drawings. The finger 70 is angled relative to the base 72 at a predetermined angle. As shown in the drawings, the finger 70 is angled outwardly and downwardly from the base 72. The base 72 is generally triangular and
30 extends substantially perpendicularly from the second end of the connecting portion 64. A generally "V" shape is formed by the first beam 60, the connecting portion 64 and the second beam 62. The base 70 and the connecting portion 64 may have the same width. The finger 72 is small and is spaced on a small pitch, for example 1mm grid.

The area of the connecting portion 64 between the first and second beams 60, 62 defines a predetermined height.

Attention is now invited to the first embodiment of the carrier 22 which is best illustrated in FIG. 4. Each aperture 34 has a width W which is slightly greater than the maximum width of either embodiment of the terminal 26, 28, a height H approximately equal to the height defined by the area of the connecting portion 46, 64 between the bases 48, 54; 66, 70, and a thickness T which is larger than the maximum thickness of either embodiment of the terminal 26, 28.

Assembly of the dual beam terminal 26 with the carrier 22 is now described. In a first embodiment, the dual beam terminal 26 is stamped and formed into the generally "V" shape as shown in FIG. 1 prior to assembly with the carrier 22. The dual beam terminal 26 is assembled with the carrier 22 by inserting the one of the beams, for example the second beam 44, through the aperture 32 in the carrier 22 until the connecting portion 46 is positioned within the aperture 32. The aperture 32 has a sufficient width W, thickness T and height H to allow the passage of the second beam 44 therethrough and to allow the connecting portion 46 to be seated therein. As a result, the first beam 42 is on the first side 30 of the carrier 22 and the second beam 44 is on the second side 32 of the carrier 22. The outer surfaces of the beams 42, 44 are exposed and the fingers 50a, 50b; 56a, 56b extend away from the carrier 22 and are angled relative to the carrier 22. After the dual beam terminal 26 is positioned within the aperture 32, a crimping tool (not shown) is used to crimp the dual beam terminal 26 to the carrier 22. The crimping tool is engaged with the outer exposed surfaces of the bases 48, 54 and is used to compress the bases 48, 54 toward each other to form a crimped joint. As a result, the bases 48, 54 may compress the material of the carrier 22 therebetween. This is repeated for as many terminals 26 as desired which are to be carried by the carrier 22 to form the LGA socket connector 20.

Alternatively, and in accordance with a second embodiment of assembling the dual beam terminal 26 to the carrier 22, the dual beam terminal 26 is stamped out of a sheet of material such that it is flat (i.e., the generally "V" shape has not yet been formed), or such that only the beam, for example the first beam 42, which will not be inserted through the carrier 22, has been formed. The dual beam terminal 26 is assembled with the carrier 22 by inserting the flat beam, for example the second beam 44, through the aperture 32 in the carrier 22 until the connecting portion 46 is positioned within the aperture 32. The aperture 32 has a sufficient width W, thickness T and height H to allow the passage of the second beam 44 therethrough and to allow the connecting portion 46 to be seated therein. As a

result, the first beam 42 is on the first side 30 of the carrier 22 and the second beam 44 is on the second side 32 of the carrier 22. The outer surfaces of the beams 42, 44 are exposed and the fingers 50a, 50b; 56a, 56b extend away from the carrier 22 and are angled relative to the carrier 22. After the dual beam terminal 26 is positioned within the aperture 32, the dual
5 beam terminal 26 is formed into its generally “V” shape by suitable means known in the art. Thereafter, a crimping tool (not shown) is used to crimp the dual beam terminal 26 to the carrier 22. The crimping tool is engaged with the outer exposed surfaces of the bases 48, 54 and is used to compress the bases 48, 54 toward each other to form a crimped joint. As a result, the bases 48, 54 may compress the material of the carrier 22 therebetween. This is
10 repeated for as many terminals 26 as desired which are to be carried by the carrier 22 to form the LGA socket connector 20.

The crimped joint allows for small pitch and provides for a low cost array. In addition, because the beams 42, 44 are small and have a small pitch, a low inductance is provided by the socket connector 20. The use of the carrier 22 is low cost and provides for a
15 low profile for the socket connector 20. The socket connector 20 is easily manufactured as a result of the uncomplicated steps for assembling same.

Assembly of the single beam terminal 28 with the carrier 22 is described. In a first embodiment, the single beam terminal 28 is stamped and formed into the generally “V” shape as shown in FIG. 2 prior to assembly with the carrier 22. The single beam terminal 28 is
20 assembled with the carrier 22 by inserting the one of the beams, for example the second beam 62, through the aperture 32 in the carrier 22 until the connecting portion 64 is positioned within the aperture 32. The aperture 32 has a sufficient width W, thickness T and height H to allow the passage of the second beam 62 therethrough and to allow the connecting portion 64 to be seated therein. As a result, the first beam 60 is on the first side 30 of the carrier 22 and
25 the second beam 62 is on the second side 32 of the carrier 22. The outer surfaces of the beams 60, 62 are exposed and the fingers 68, 72 extend away from the carrier 22 and are angled relative to the carrier 22. After the single beam terminal 28 is positioned within the aperture 32, a crimping tool (not shown) is used to crimp the single beam terminal 28 to the carrier 22. The crimping tool is engaged with the outer exposed surfaces of the bases 66, 70
30 and is used to compress the bases 66, 70 toward each other to form a crimped joint. As a result, the bases 66, 70 may compress the material of the carrier 22 therebetween. This is repeated for as many terminals 28 as desired which are to be carried by the carrier 22 to form the LGA socket connector 20.

Alternatively, and in accordance with a second embodiment of assembling the single beam terminal 28 to the carrier 22, the single beam terminal 28 is stamped out of a sheet of material such that it is flat (i.e., the generally "V" shape has not yet been formed), or such that only the beam, for example the first beam 60, which will not be inserted through the carrier 22, has been formed. The single beam terminal 28 is assembled with the carrier 22 by inserting the flat beam, for example the second beam 62, through the aperture 32 in the carrier 22 until the connecting portion 64 is positioned within the aperture 32. The aperture 32 has a sufficient width W, thickness T and height H to allow the passage of the second beam 62 therethrough and to allow the connecting portion 64 to be seated therein. As a result, the first beam 60 is on the first side 30 of the carrier 22 and the second beam 62 is on the second side 32 of the carrier 22. The outer surfaces of the beams 60, 62 are exposed and the fingers 68, 72 extend away from the carrier 22 and are angled relative to the carrier 22. After the single beam terminal 28 is positioned within the aperture 32, the single beam terminal 28 is formed into its generally "V" shape by suitable means known in the art. Thereafter, a crimping tool (not shown) is used to crimp the single beam terminal 28 to the carrier 22. The crimping tool is engaged with the outer exposed surfaces of the bases 66, 70 and is used to compress the bases 66, 70 toward each other to form a crimped joint. As a result, the bases 66, 70 may compress the material of the carrier 22 therebetween. This is repeated for as many terminals 28 as desired which are to be carried by the carrier 22 to form the LGA socket connector 20.

The crimped joint allows for small pitch and provides for a low cost array. In addition, because the beams 60, 62 are small and have a small pitch, a low inductance is provided by the socket connector 20. The use of the carrier 22 is low cost and provides for a low profile for the socket connector 20. The socket connector 20 is easily manufactured as a result of the uncomplicated steps for assembling same.

Attention is now invited to the second embodiment of the carrier 24 which is best illustrated in FIG. 8. The apertures 40a, 40b in each pair are defined by a first aperture 40a and a second aperture 40b and are spaced apart from each other by a predetermined distance. Each first aperture 40a has a width W' which is slightly greater than the maximum width of either embodiment of the terminal 26, 28, a height H' which is approximately equal to the height defined by the area of the connecting portion 46; 64 between the bases 48, 54; 66, 70, and a thickness T' which is larger than the maximum thickness of either embodiment of the terminal 26, 28. The second aperture 40a has a thickness T'' and a width W'' which is substantially equal to the thickness and the width of either terminal 26, 28.

Assembly of the dual beam terminal 26 with the carrier 24 is described. In a first embodiment, the dual beam terminal 26 is stamped and formed into the generally "V" shape as shown in FIG. 1 prior to assembly with the carrier 24. The dual beam terminal 26 is assembled with the carrier 22 by inserting the one of the beams, for example the second beam 44, through the aperture 40a in the carrier 24 until the connecting portion 46 is positioned within the aperture 40a. The aperture 40a has a sufficient width W', thickness T' and height H' to allow the passage of the second beam 44 therethrough and to allow the connecting portion 46 to be seated therein. The second aperture 40b is positioned between the joints formed between the fingers 50a, 50b; 56a, 56b and the bases 48; 54. As a result, the first beam 42 is on the first side 36 of the carrier 24 and the second beam 44 is on the second side 38 of the carrier 24. The outer surfaces of the beams 42, 44 are exposed and the fingers 50a, 50b; 56a, 56b extend away from the carrier 24 and are angled relative to the carrier 24. After the dual beam terminal 26 is positioned within the aperture 40a, a crimping tool (not shown) is used to crimp the dual beam terminal 26 to the carrier 24. The crimping tool is engaged with the outer exposed surfaces of the bases 48, 54 and is used to compress the bases 48, 54 toward each other to form a crimped joint. As a result, the bases 48, 54 may compress the material of the carrier 24 therebetween. In addition, a portion of the bases 48, 54 enter into the second aperture 40b and as a result, stress on the carrier 24 which is caused by the compression of the material of the carrier 24 between the bases 48, 54 is relieved (thereby minimizing any wrinkling of the carrier 24 which otherwise may occur). This is repeated for as many terminals 26 as desired which are to be carried by the carrier 24 to form the LGA socket connector 20.

Alternatively, and in accordance with a second embodiment of assembling the dual beam terminal 26 to the carrier 24, the dual beam terminal 26 is stamped out of a sheet of material such that it is flat (i.e., the generally "V" shape has not yet been formed), or such that only the beam, for example the first beam 42, which will not be inserted through the carrier 24, has been formed. The dual beam terminal 26 is assembled with the carrier 24 by inserting the one of the beams, for example the second beam 44, through the aperture 40a in the carrier 24 until the connecting portion 46 is positioned within the aperture 40a. The aperture 40a has a sufficient width W', thickness T' and height H' to allow the passage of the second beam 44 therethrough and to allow the connecting portion 46 to be seated therein. The second aperture 40b is between the joints formed between the fingers 50a, 50b; 56a, 56b and the bases 48; 54. As a result, the first beam 42 is on the first side 36 of the carrier 24 and the second beam 44 is on the second side 38 of the carrier 24. The outer surfaces of the

beams 42, 44 are exposed and the fingers 50a, 50b; 56a, 56b extend away from the carrier 24 and are angled relative to the carrier 24. After the dual beam terminal 26 is positioned within the aperture 40a, the dual beam terminal 26 is formed into its generally "V" shape by suitable means known in the art. Thereafter, a crimping tool (not shown) is used to crimp the dual beam terminal 26 to the carrier 24. The crimping tool is engaged with the outer exposed surfaces of the bases 48, 54 and is used to compress the bases 48, 54 toward each other to form a crimped joint. As a result, the bases 48, 54 may compress the material of the carrier 24 therebetween. In addition, a portion of the bases 48, 54 enter into the second aperture 40b and as a result, stress on the carrier 24 which is caused by the compression of the material of the carrier 24 between the bases 48, 54 is relieved (thereby minimizing any wrinkling of the carrier which otherwise may occur). This is repeated for as many terminals 26 as desired which are to be carried by the carrier 24 to form the LGA socket connector 20.

The crimped joint allows for small pitch and provides for a low cost array. In addition, because the beams 42, 44 are small and have a small pitch, a low inductance is provided by the socket connector 20. The use of the carrier 24 is low cost and provides for a low profile for the socket connector 20. The socket connector 20 is easily manufactured as a result of the uncomplicated steps for assembling same.

Assembly of the single beam terminal 28 with the carrier 24 is described. In a first embodiment, the single beam terminal 28 is stamped and formed into the generally "V" shape as shown in FIG. 2 prior to assembly with the carrier 24. The single beam terminal 28 is assembled with the carrier 24 by inserting the one of the beams, for example the second beam 62, through the aperture 40a in the carrier 24 until the connecting portion 64 is positioned within the aperture 40a. The aperture 40a has a sufficient width W' , thickness T' and height H' to allow the passage of the second beam 62 therethrough and to allow the connecting portion 64 to be seated therein. As a result, the first beam 60 is on the first side 36 of the carrier 24 and the second beam 62 is on the second side 38 of the carrier 24. The outer surfaces of the beams 60, 62 are exposed and the fingers 68, 72 extend away from the carrier 24 and are angled relative to the carrier 24. After the single beam terminal 28 is positioned within the aperture 40a, a crimping tool (not shown) is used to crimp the single beam terminal 28 to the carrier 24. The crimping tool is engaged with the outer exposed surfaces of the bases 66, 70 and is used to compress the bases 66, 70 toward each other to form a crimped joint. As a result, the bases 66, 70 may compress the material of the carrier 24 therebetween. This is repeated for as many terminals 28 as desired which are to be carried by the carrier 24 to form the LGA socket connector 20.

Alternatively, and in accordance with a second embodiment of assembling the single beam terminal 28 to the carrier 24, the single beam terminal 28 is stamped out of a sheet of material such that it is flat (i.e., the generally "V" shape has not yet been formed), or such that only the beam, for example the first beam 60, which will not be inserted through the carrier 24, has been formed. The single beam terminal 28 is assembled with the carrier 24 by inserting the one of the beams, for example the second beam 62, through the aperture 40a in the carrier 24 until the connecting portion 64 is positioned within the aperture 40a. The aperture 40a has a sufficient width W' , thickness T' and height H' to allow the passage of the second beam 62 therethrough and to allow the connecting portion 64 to be seated therein. As a result, the first beam 60 is on the first side 36 of the carrier 24 and the second beam 62 is on the second side 38 of the carrier 24. The outer surfaces of the beams 60, 62 are exposed and the fingers 68, 72 extend away from the carrier 24 and are angled relative to the carrier 24. After the single beam terminal 28 is positioned within the aperture 40a, the single beam terminal 28 is formed into its generally "V" shape by suitable means known in the art. Thereafter, a crimping tool (not shown) is used to crimp the single beam terminal 28 to the carrier 24. The crimping tool is engaged with the outer exposed surfaces of the bases 66, 70 and is used to compress the bases 66, 70 toward each other to form a crimped joint. As a result, the bases 66, 70 may compress the material of the carrier 24 therebetween. This is repeated for as many terminals 28 as desired which are to be carried by the carrier 24 to form the LGA socket connector 20.

The crimped joint allows for small pitch and provides for a low cost array. In addition, because the beams 60, 62 are small and have a small pitch, a low inductance is provided by the socket connector 20. The use of the carrier 24 is low cost and provides for a low profile for the socket connector 20. The socket connector 20 is easily manufactured as a result of the uncomplicated steps for assembling same.

As shown in FIG. 3, the first beam 42, 60 of the terminal 26, 28 is suited for engagement with a chip package or other appropriate electronic component 74 and the second beam 44, 62 of the terminal 26, 28 is suited for engagement with a printed circuit board or other appropriate electronic component 76. The elongation and the angling of the beams 42, 44; 60, 62 allows for the flexure of the beams 42, 44; 60, 62 to provide for a secure connection to the electronic components 74, 76. The provision of the dual fingers 50a, 50b, 56a, 56b in the dual beam terminal 26 provides for a redundancy for the electrical connection to the electronic components 74, 76 in the even that one of the fingers fails.

The dual beam terminals 26 can be inserted individually into the carrier 22, 24 as shown in FIGS. 4 and 8, inserted as an array 78 as shown in FIG. 10 into the carrier 22, 24, or inserted as a strip 80 as shown in FIGS. 11 and 12 into the carrier 22, 24. If the dual beam terminals 26 are inserted into the carrier 22, 24 in strip form or array form, the framework 82, 84 which mates the dual beam terminals 26 together are removed after assembly by suitable means, such as by cutting the framework 82, 84 away or etching, to remove the electrical connection between the dual beam terminals 26. The single beam terminals 28 can be inserted into the carrier 22, 24 in the same manner.

Because the carrier 22, 24 is flexible, a stiffening framework 86 can be provided around the perimeter of the carrier as shown for example in FIG. 13. The stiffening framework 86 can be made of plastic or the like.

As shown in FIG. 14, a coverlay 88 can be provided on the exposed surfaces 30, 32; 36, 38 of the carrier 22, 24 between the terminals 26 to prevent the electrical engagement of adjacent beams when the beams are deflected upon engagement with the electrical components 74, 76. The coverlay 88 is formed from a dielectric material and is secured to the exposed surfaces 30, 32; 36, 38 of the carrier 22, 24 by suitable means, such as adhesive. The coverlay 88 extends outwardly from the surfaces 30, 32; 36, 38 of the carrier 22, 24 a predetermined distance and is engaged by the fingers 50a, 50b; 56a, 56b when the terminals 26, 28 are in the fully deflected condition such that the coverlays 88 prevent the engagement of a finger or fingers 50a, 50b; 56a, 56b with an adjacent terminal 26 when fully deflected condition. Alternatively, a dielectric material can be dispensed onto portions of the exposed surfaces of the carrier 22, 24 to perform the same function. The coverlay 88 can be a conformal coating, or a solder mask. The coverlay 88 can also be used with the single beam terminal 28.

If desired, a solder ball 90 can be provided on the end of one of the beams, for example beam 44 to provide for a ball grid array attachment to the printed circuit board 72. The beam 44 preferably includes a section 92 which is angled to the remainder of the fingers 56a, 56b such that it is parallel to the printed circuit board 92 for attachment of the solder ball 90 thereto. The solder ball 90 can be attached to the single beam terminal 28 in a like manner. In another embodiment, the solder ball 90 can be attached to a non-flexible portion (not shown) of the single beam terminal 28 or the dual beam terminal 26.

Electrical traces (not shown) may be provided on the carrier 22, 24 between desired ones of the terminals 26; 28 to electrically connect same.

As described above and as shown in the drawings, the carrier 22, 24 is generally planar. As shown in FIGS. 5a and 6a, the first side 30 of the carrier 22 may include an inclined stopper 30a associated with each aperture 34. The stopper 30a is provided at a predetermined distance from the aperture 34 such that when the terminal 26 is inserted into
5 the carrier 22, the stopper 30a is proximate to the first beam 44. The stopper 30a acts to prevent over-travel of the fingers 50a, 50b. The stopper 30a includes an inclined portion 30b that is inclined at the same angle as the fingers 50a, 50b of the beam 44 and the width of the stopper 30a is the same as the width W' of the fingers 50a, 50b. Stoppers (not shown) may be provided on the second side 32 of the carrier 22. Stoppers can be used with the second
10 embodiment of the terminal 28 and with the second embodiment of the carrier 24.

While preferred embodiments of the present invention are shown and described, it is envisioned that those skilled in the art may devise various modifications of the present invention without departing from the spirit and scope of the appended claims.

CLAIMS:

What is claimed is:

1. A connector comprising:

a flexible, dielectric carrier having first and second opposite sides and an aperture provided therethrough extending from said first side to said second side;

a conductive terminal mounted through the aperture in the carrier, the terminal having

5 a connecting portion extending through the aperture, a first beam extending from the connecting portion and provided on the first side of the carrier, said first beam being angled relative to said first side of carrier, and a second beam extending from the connecting portion and provided on the second side of the carrier, said second beam being angled relative to said second side of said carrier;

10 said terminal being crimped to the carrier thereby forming a crimped joint between said terminal and said carrier.

2. The connector of claim 1, wherein the connecting portion, the first beam and the second beam are integrally formed as a one piece member.

3. The connector of claim 1, wherein the first beam is formed of two spaced apart fingers extending from the connecting portion and the second beam is formed of two spaced apart fingers extending from the connecting portion.

4. The connector of claim 1, wherein the first beam is formed of a single finger extending from the connecting portion and the second beam is formed of a single finger extending from the connecting portion.

5. The connector of claim 1, wherein the aperture has a predetermined height which is approximately the same as a height defined by the connecting portion between the first and second beams.

6. The connector of claim 1, wherein the terminal has a predetermined maximum width and a predetermined maximum thickness, and the aperture has a width which is greater than the predetermined maximum width of the terminal and a thickness which is greater than the predetermined maximum thickness of the terminal.

7. The connector of claim 1, further including a coverlay formed of a dielectric material over at least one of said sides of said carrier.
8. The connector of claim 1, further including a stiffening framework around a perimeter of said carrier.
9. The connector of claim 1, further including a solder ball provided on an end of one of said beams.
10. The connector of claim 1, wherein said second beam includes a first section extending at an angle from said connecting portion and a second section extending from said first section, said second section being generally parallel to said carrier, and a solder ball mounted on said second section.
11. The connector of claim 1, wherein said carrier further includes an inclined portion provided at a predetermined distance from the aperture on said first side of said carrier, said inclined portion being inclined at approximately the same angle as the first beam is angled relative to said carrier.
12. The connector of claim 11, wherein said inclined portion has a width which is approximately equal to a width of the first beam.
13. The connector of claim 1, further including a second aperture proximate said first defined aperture, and wherein when the terminal is crimped to the carrier, said first and second beams enter into said second aperture.
14. The connector of claim 13, wherein the terminal has a predetermined maximum width and a predetermined maximum thickness, and said second aperture has a width which is greater than the predetermined maximum width of the terminal and a thickness which is greater than the predetermined maximum thickness of the terminal.
15. The connector of claim 1, wherein a plurality of terminals are mounted on the carrier through associated apertures.

16. The connector of claim 15, wherein the apertures are provided in an array.

17. The connector of claim 15, wherein the plurality of terminals are connected together by a framework that is removed once the terminals are inserted through the apertures.

18. The connector of claim 17, wherein the terminals are laid out in an array.

19. The connector of claim 17, wherein the terminals are laid out in a strip.

20. A method of assembling a socket connector comprising the steps of:
providing an aperture through a carrier, the carrier having first and second opposite sides;

5 providing a terminal having a connecting portion, a first beam extending from the connecting portion and a second beam extending from the connecting portion;

passing one of the first and second beams through the aperture in the carrier until the connecting portion is positioned within the aperture and the first beam is on the first side of the carrier and the second beam is on the second side of the carrier; and

crimping the terminal to the carrier.

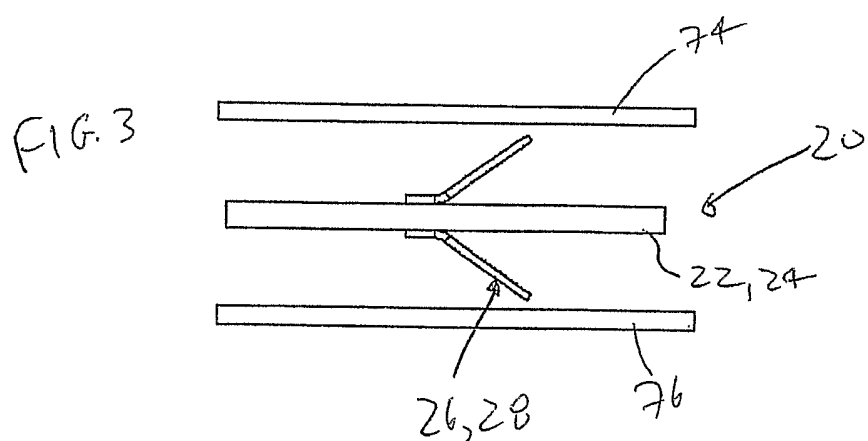
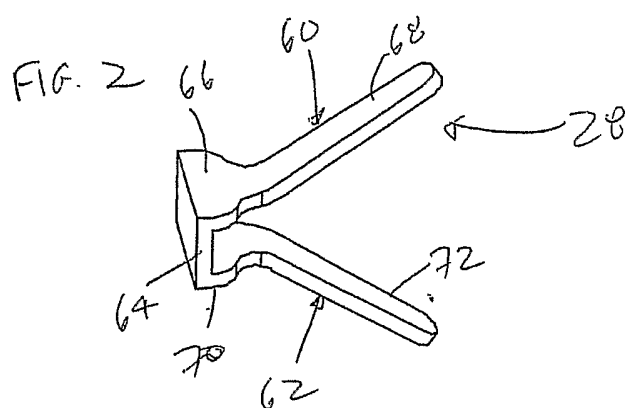
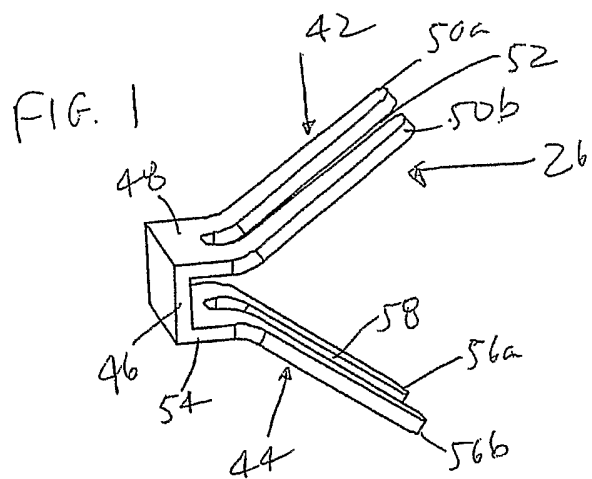
21. The method of claim 20, further including the step of providing a coverlay over at least one of the sides of the carrier.

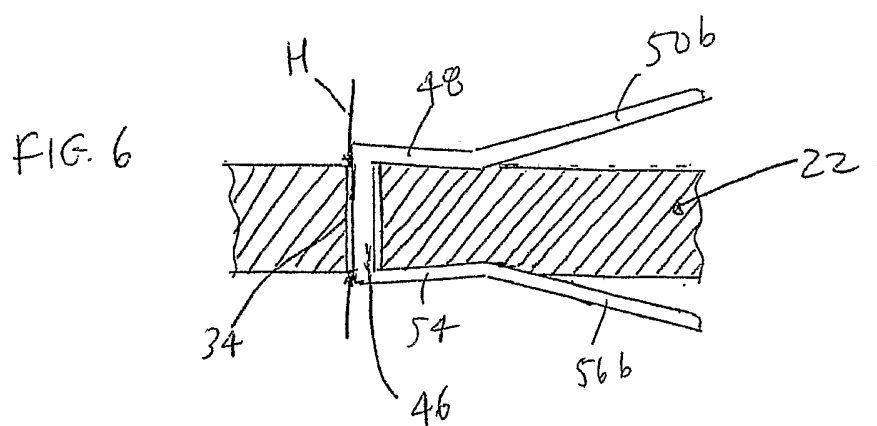
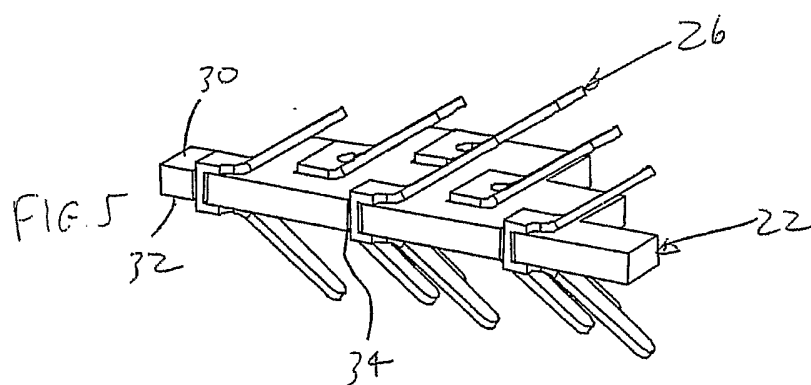
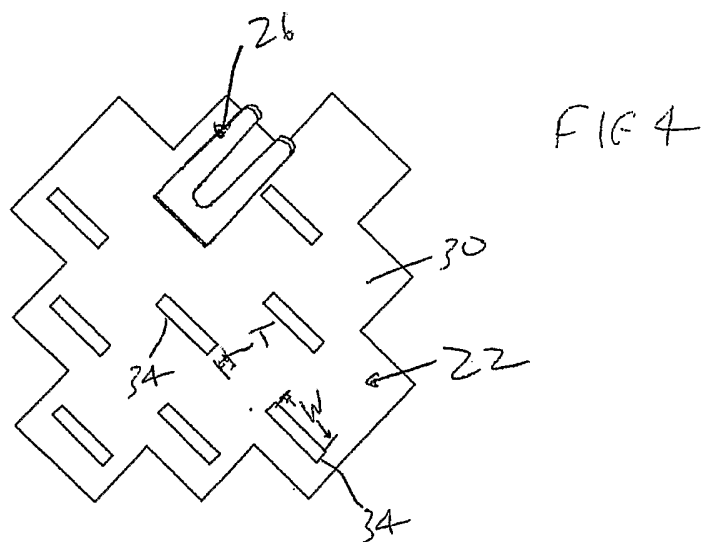
22. The method of claim 20, further including the step of providing a stiffening framework around a perimeter of the carrier.

23. The method of claim 20, further including the step of providing a second aperture proximate the first defined aperture and wherein during the step of crimping, the beams enter into the second aperture.

24. The method of claim 20, further including the steps of providing a plurality of the apertures and providing a plurality of the terminals.

25. The method of claim 24, wherein the plurality of terminals are connected by a framework and the framework is removed after the terminals are inserted into the apertures.





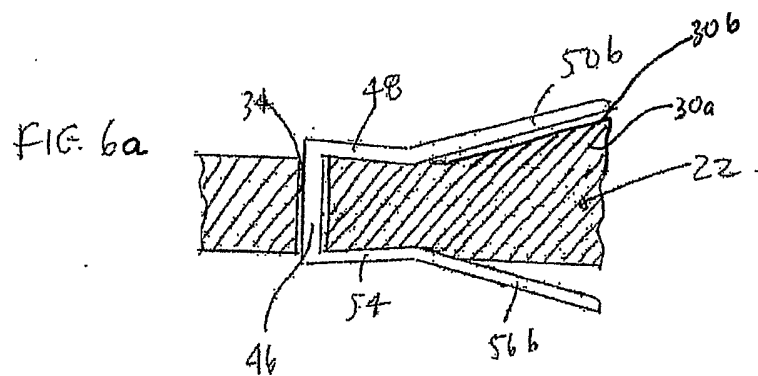
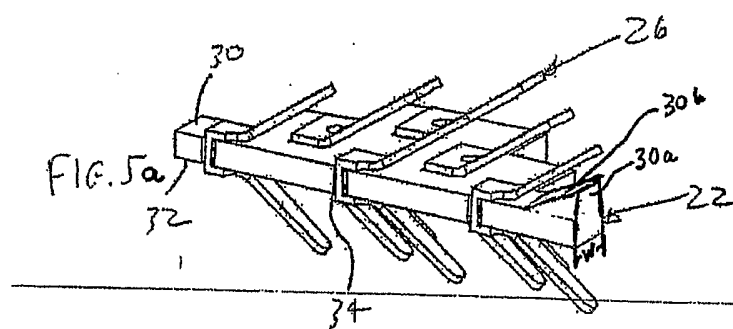
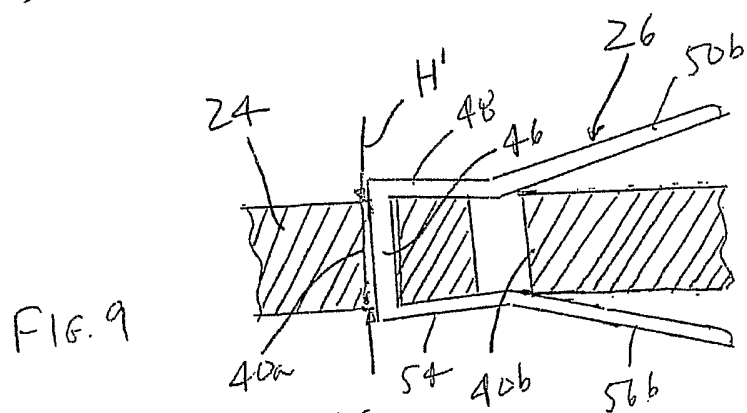
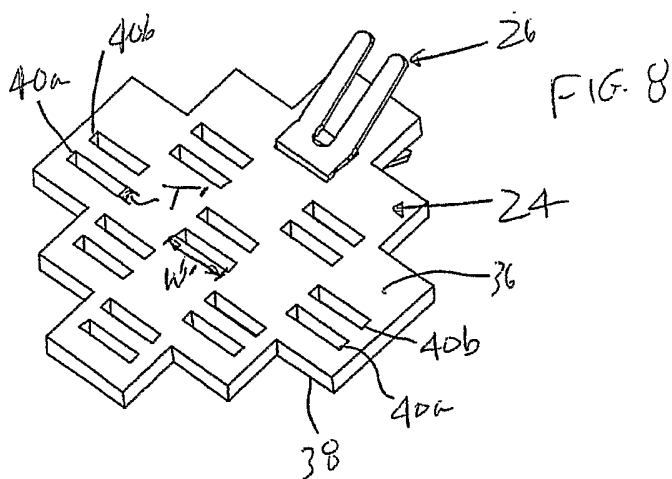
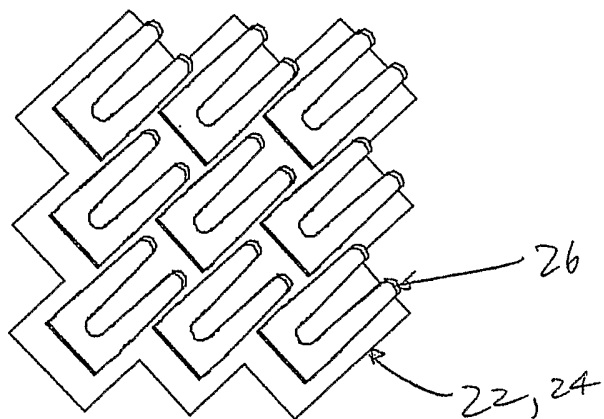
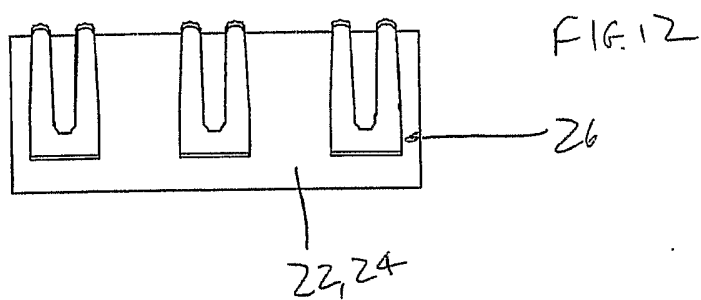
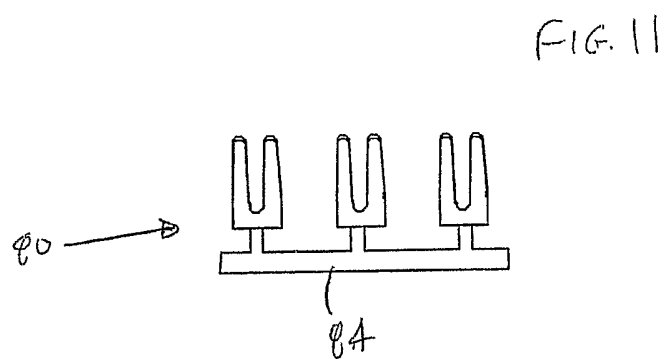
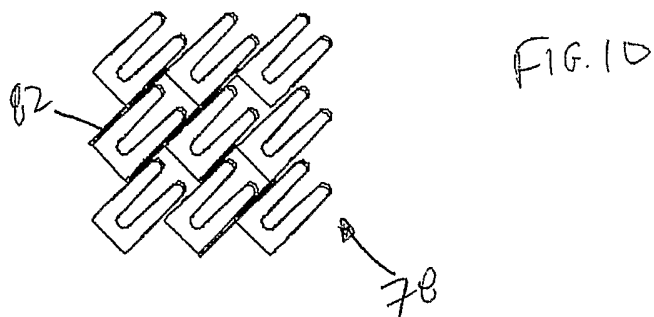
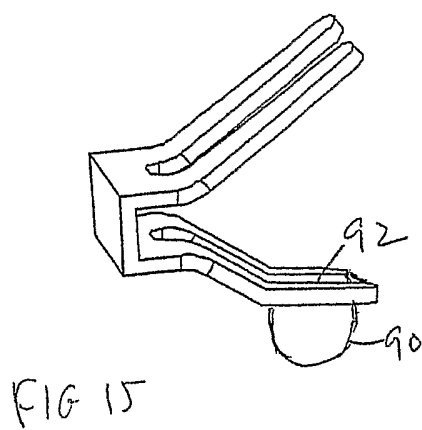
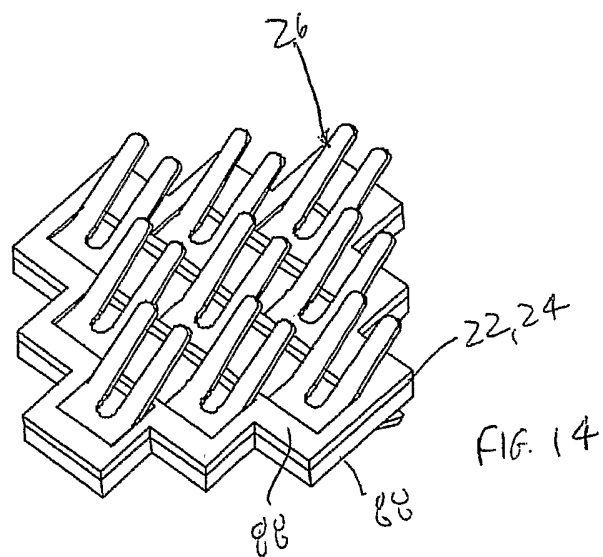
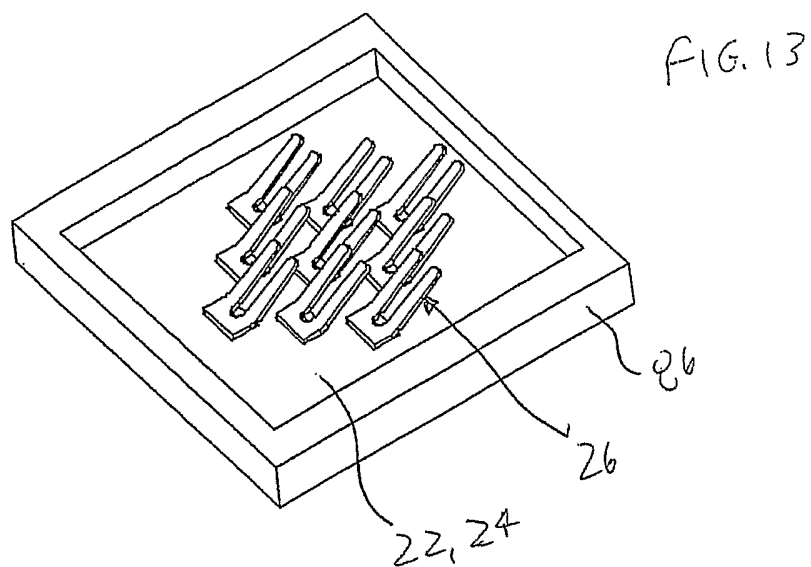


FIG. 7







INTERNATIONAL SEARCH REPORT

Application No
PCT/US2004/037235

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R13/24 H05K7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 228 861 A (GRABBE ET AL) 20 July 1993 (1993-07-20) column 3, line 26 - column 4, line 30 column 6, line 55 - column 7, line 15 figures 1,10-12	1,2,4,5, 15,16 20
Y A	EP 0 903 811 A (MATRA MARCONI SPACE FRANCE) 24 March 1999 (1999-03-24) abstract column 4, lines 6-44; figures 1-5	20,24,25 1
Y	US 2002/141123 A1 (BISHOP PETER ET AL) 3 October 2002 (2002-10-03) abstract page 1, paragraph 12; figures 7,8 ----- -/--	20,24,25



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

11 March 2005

Date of mailing of the international search report

22/03/2005

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INTERNATIONAL SEARCH REPORT

Application No

PCT/US2004/037235

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 384 438 A (AMP INCORPORATED ; THE WHITAKER CORPORATION) 29 August 1990 (1990-08-29) abstract; figures 3-6 -----	1,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

Application No

PCT/US2004/037235

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5228861	A	20-07-1993	DE 4319081 A1	16-12-1993
			JP 2746819 B2	06-05-1998
			JP 6096819 A	08-04-1994
EP 0903811	A	24-03-1999	FR 2768896 A1	26-03-1999
			EP 0903811 A1	24-03-1999
US 2002141123	A1	03-10-2002	CN 1439185 A	27-08-2003
			DE 10196271 T5	29-04-2004
			GB 2378828 A ,B	19-02-2003
			JP 2004520630 T	08-07-2004
			WO 02095876 A1	28-11-2002
EP 0384438	A	29-08-1990	US 4952156 A	28-08-1990
			DE 69015224 D1	02-02-1995
			DE 69015224 T2	11-05-1995
			EP 0384438 A1	29-08-1990