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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **H01R 13/115** | **A1**

(11) International Publication Number: **WO 95/17028**

(43) International Publication Date: 22 June 1995 (22.06.95)

(21) International Application Number: PCT/US94/14411

(22) International Filing Date: 13 December 1994 (13.12.94)

(30) Priority Data:
08/169,586 17 December 1993 (17.12.93) US

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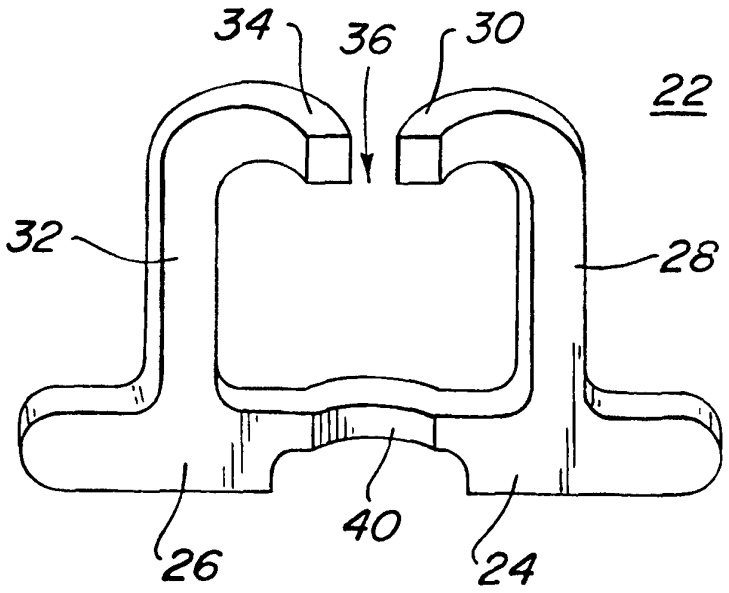
(81) Designated States: JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
With amended claims and statement.

(54) Title: CONNECTOR FOR HIGH DENSITY ELECTRONIC ASSEMBLIES

(57) Abstract

An electrical connector includes a housing (20) and a plurality of terminals (22) secured within the housing for mounting a mating connector (16) or an electronic module or the like having a plurality of electronic leads (18) disposed thereon to a printed substrate (12). A first contact beam (28) is cantilevered from a base portion (24) and has a distal end (30), while a second contact beam (32) is similarly cantilevered from a base portion (26) and also has a distal end (34) wherein a gap (36) is formed between the distal ends of the contact beams. The leads of the mating connectors of the like are inserted into the gap for contacting engagement with the contact beams. A gap adjustment (40) integrally connected to the base portion provides for simple adjustment of the size of the gap between the contact beams.



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CONNECTOR FOR HIGH DENSITY ELECTRONIC ASSEMBLIES

FIELD OF THE INVENTION

This invention relates to a connector having a plurality of terminals for connecting a mating connector or the like to a circuit board. More particularly, this invention relates to a connector having a plurality of terminals wherein each terminal comprises two resilient contact beams having free distal ends which are separated by a gap for receiving a lead of a mating connector or the like and wherein a gap adjustment provides for simple adjustment of the size of the gap.

BACKGROUND OF THE INVENTION

Miniature and portable electronic devices are among the fastest growing segments of the electronics industry. Among these devices are cellular phones operating with a ground cell network, satellite communication net terminals, laser and infrared measurement instruments, and work-stations including combinations of personal computers, facsimile machines with voice telecommunication terminals and notebook computers.

An important trend in the electronics industry has been the increasing utilization of integrated circuits as individual components due to their relatively inexpensive cost, miniature size, and electrical dependability. Today it is common for hundreds of complex integrated circuits to be treated as discrete components by the design engineer, with such integrated circuits being appropriately packaged and electrically connected to their associated printed circuit boards.

Many of the current electronic designs contain a variety of components such as, flexible, rigid, and semi-rigid printed circuit boards, hybrid circuits and large silicon integrated circuits. These components must be mounted together by electrical connectors having a plurality of terminal contacts which provide for inexpensive latching and containment of the electronic components.

Connectors having tuning fork type dual beam contact terminals wherein a gap is provided between the contact terminals are known for providing a mounting connection between an electronics package and a printed circuit board or the like. Leads of the electronics package are inserted into the gap for making contact with one or both of the contact terminals such that the electronics package is electrically interconnected with the printed circuit board. However, in order to manufacture these types of terminal having an extremely small gap size, the punching device which forms the gap from the terminal material during a stamping operation must also be extremely small. However, due to the forces exerted on the punching devices during a stamping operation, small punch devices are prone to breaking under the influence of such forces.

Therefore, there is a need for a low cost, high density connector having a plurality of terminal contacts which can be simply manufactured, allows for simple and effective regulation of insertion forces, has the strength necessary for providing a reliable connection between an electronic module or the like and a printed circuit board and which can be simply adjusted to provide a varying gap size between terminal contacts. The present invention provides an electrical connector which satisfies this need.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide an improved connector for a high-density electronic module, mating connector or the like that is inexpensive and simple in construction.

An electrical connector in accordance with the present invention comprises a housing and a plurality of terminals secured in the housing for connecting a mating connector or the like to a printed substrate. Each of the terminals has a first and second base portion. The first base portion has a first contact beam cantilevered therefrom, with the first contact beam having a first distal end. Similarly, the second base portion has a second contact beam cantilevered therefrom, with the second contact beam having a second distal end, and wherein a gap is formed between the first and second distal ends. The first and second contact beams are for receiving an electrical lead inserted in the gap such that the electrical lead contacts at least one of the distal ends for establishing electrical connection between the lead and the printed substrate and for providing reliable mounting of the mating connector on the printed substrate. A gap adjustment is integrally connected between the first and second base portions for adjusting the size of the gap.

These and various other advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an exploded perspective view of a connector in accordance with the present invention.

FIGURE 2 is a perspective view of a connector terminal in accordance with the present invention.

FIGURE 3 is a perspective view of a second embodiment of a connector terminal in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring now to the drawings, wherein like reference numerals designate corresponding structure throughout the views, and referring in particular to FIGURE 1, an improved connector 10 is constructed and arranged to be attached to a motherboard or substrate 12 that has contacts 14, preferably comprising copper, thereon. Contacts 14 can be pads of solder disposed on substrate 12 in a known manner or plated through holes. Substrate 12 can be a printed circuit board or the like having electronic circuitry printed thereon for carrying out specific functions in a known manner. Connector 10 is adapted to receive an electronic male connector 16 that is of the type that has a plurality of leads 18 positioned on an underside thereof. Leads 18 can be, for example, contact pins that are bent downwardly orthogonally to the plane of the male connector 16 as shown in FIGURE 1. However, the present invention is not intended to be limited in this manner and connector 10 can be adapted to receive a variety of electronic modules or the like, as set forth in further detail below, such as a thin card-type electronic module having a plurality of flat contact pad leads positioned on an underside thereof and adjacent to one or more edges of the electronic module.

Connector 10 includes a housing 20 preferably fabricated from a non-conductive, non-metallic material, such as hard plastic. A plurality of connector terminals 22 are positioned in and securely mounted in housing 20. Terminals 22 preferably comprise a material having a high electrical conductivity and high elastic modulus, such as phosphorous bronze or beryllium bronze, and can be formed by any known manufacturing method, such as stamping or etching.

As shown in FIGURE 2, a terminal 22 includes base portions 24, 26. A resilient first contact beam 28 is cantilevered from base portion 24 and has a distal end 30. Similarly, a resilient second contact beam 32 is cantilevered from base portion 26 and has a distal end 34. The longitudinal plane of terminal 22 is herein defined as that plane in which

contact beams 28, 32 are cantilevered from their respective base portions 24, 26. A gap 36 is formed between the distal ends 30, 34 of the contact beams 28, 32 and the contact beams receive lead 18 inserted in the gap 36, as shown in FIGURE 1, such that the electrical lead 18 contacts at least one of the distal ends 30, 34 for establishing electrical connection between the lead and the printed substrate 12. As shown in the embodiment of FIGURE 2, distal ends 30, 34 can be bent at an angle to the longitudinal plane of the terminal. In a preferred embodiment, distal ends 30, 34 are bent orthogonally to the longitudinal plane of the terminal. In this embodiment, the leads of a mating connector or the like are inserted substantially perpendicular to the longitudinal plane of the terminal.

The terminal embodiment shown in FIGURE 2 can be surface mounted to the contact pads of a printed circuit board or the like wherein base portions 24, 26 are solderably connected to the contact pads in a known manner. However, the present invention is not intended to be limited in this manner and various other types of terminal mounting techniques are within the scope of the invention. For example, the terminal embodiment shown in FIGURE 3 includes an attachment tail 39 which can be mounted in a plated through hole in the printed substrate in a known manner for connecting the terminal to a contact pad on the circuit board.

As discussed above, where a particular application requires that connector 10 is connected to an edge card type connector having a plurality of leads on one of the sides thereof, the edge of the card is disposed in the gaps of the adjacent terminals such that the leads contact the distal end of one of the contact beams of the connector terminal.

Gap adjustment 40 is disposed between and integrally joins base portions 24, 26. Gap adjustment 40 can be adjusted to provide a desired size for the gap 36 between the distal ends of the contact beams. In the embodiment shown in FIGURE 2, gap adjustment 40 has a curved profile which projects a

predetermined depth outside of the longitudinal plane of the terminal. This profile and depth correspond to a particular gap size.

Thus, a terminal 22 is manufactured by forming a quantity of terminal material, preferably by stamping, into a desired terminal profile, such as that shown in FIGURES 2 and 3.

In order to adjust the gap size, the depth or the profile, or both, of the gap adjustment 40 is altered to obtain the desired gap size. The gap adjustment can be altered by displacing the gap adjustment material to change the depth at which the gap adjustment extends outside of the longitudinal plane of the terminal and/or by displacing the gap adjustment material to change the profile of the gap adjustment while maintaining a specified depth. It is preferable to form the shape of the gap adjustment for a desired gap size such that the base portions 24, 26 remain aligned in parallel in the longitudinal plane of the terminal.

Thus, a connector in accordance with the present invention provides low cost, low-profile connector terminals which can be densely packed together and which provide a reliable latching mechanism for securing a mating connector or the like into electrical connection with a printed substrate. The connector terminals can be simply modified to receive variable size leads of a mating connector or the like.

Although particular embodiments of the present invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art. Consequently, it is intended that the claims be intended to cover such modifications and equivalents.

WHAT IS CLAIMED IS:

1. An electrical connector, comprising:

a housing;

a plurality of terminals secured in said housing, each of said terminals having:

a first and second base portion, lying substantially in a common plane, said first base portion having a first contact beam cantilevered therefrom, said first contact beam having a first distal end, said second base portion having a second contact beam cantilevered therefrom, said second contact beam having a second distal end, wherein a gap is formed between said first and second distal ends, said first and second contact beams for receiving an electrical lead inserted in said gap such that the electrical lead contacts at least one of said distal ends for establishing electrical connection between the lead and the printed substrate; and

gap adjustment means for adjusting the size of said gap, said gap adjustment means integrally joining said first and second base portions and being bowed out of said plane.

2. An electrical connector according to claim 1, each said terminal constructed such that said first and second base portions and said first and second contact beams are aligned in said plane, wherein said first and second distal ends are bent at an angle to said plane.

3. An electrical connector according to claim 2, wherein said first and second distal ends are bent orthogonally to said plane.

4. An electrical connector according to claim 2, wherein said gap adjustment means has a curved profile projecting outside of said plane.

5. An electrical connector according to claim 1, wherein said gap adjustment means is altered by displacing the material of the gap adjustment means to provide a desired gap size.

6. An electrical connector according to claim 1, each said terminal further having an attachment tail for mounting said terminal in a plated through hole in a printed substrate.

7. A connector terminal, comprising:

a first and second base portion lying substantially in a common plane, said first base portion having a first contact beam cantilevered therefrom, said first contact beam having a first distal end, said second base portion having a second contact beam cantilevered therefrom, said second contact beam having a second distal end, wherein a gap is formed between said first and second distal ends, said first and second contact beams for receiving an electrical lead inserted in said gap such that the electrical lead contacts at least one of said distal ends for establishing electrical connection between the lead and the printed substrate; and

gap adjustment means for adjusting the size of said gap, said gap adjustment means integrally joining said first and second base portions.

8. A method of manufacturing a connector terminal, comprising:

providing a quantity of terminal material;

forming said quantity of terminal material into:

a first base portion having a first contact beam cantilevered therefrom, said first contact beam having a first distal end;

a second base portion having a second contact beam cantilevered therefrom, said second contact beam

having a second distal end, wherein a gap is formed between said first and second distal ends;

an intermediate portion disposed between and integral with said first and second base portions; and

displacing an amount of said terminal material at said intermediate portion to adjust the size of said gap.

9. The method according to claim 8, wherein said forming step is carried out in a stamping operation.

10. The method according to claim 9, wherein said displacing step is carried out in a stamping operation.

11. The method according to claim 8, wherein said terminal material is substantially planar, and wherein said displacing step comprises displacing a portion of said intermediate portion out of the plane of said terminal material.

AMENDED CLAIMS

[received by the International Bureau on 28 February 1995 (28.02.95); original claim 7 amended; remaining claims unchanged (1 page)]

5. An electrical connector according to claim 1, wherein said gap adjustment means is altered by displacing the material of the gap adjustment means to provide a desired gap size.

6. An electrical connector according to claim 1, each said terminal further having an attachment tail for mounting said terminal in a plated through hole in a printed substrate.

7. A connector terminal, comprising:

a first and second base portion lying substantially in a common plane, said first base portion having a first contact beam cantilevered therefrom, said first contact beam having a first distal end, said second base portion having a second contact beam cantilevered therefrom, said second contact beam having a second distal end, wherein a gap is formed between said first and second distal ends, said first and second contact beams for receiving an electrical lead inserted in said gap such that the electrical lead contacts at least one of said distal ends for establishing electrical connection between the lead and the printed substrate; and

gap adjustment means for adjusting the size of said gap, said gap adjustment means integrally joining said first and second base portions and being bowed out of said plane.

8. A method of manufacturing a connector terminal, comprising:

providing a quantity of terminal material;

forming said quantity of terminal material into:

a first base portion having a first contact beam cantilevered therefrom, said first contact beam having a first distal end;

a second base portion having a second contact beam cantilevered therefrom, said second contact beam

STATEMENT UNDER ARTICLE 19

Claim 7 has been amended in order to conform the application to the corresponding U.S. application S.N. 08/169,586, filed 17 December 1993, and allowed by the U.S. Patent Office on 7 November 1994. Claims 1-6 and 8-11 are unchanged.

FIG. 1

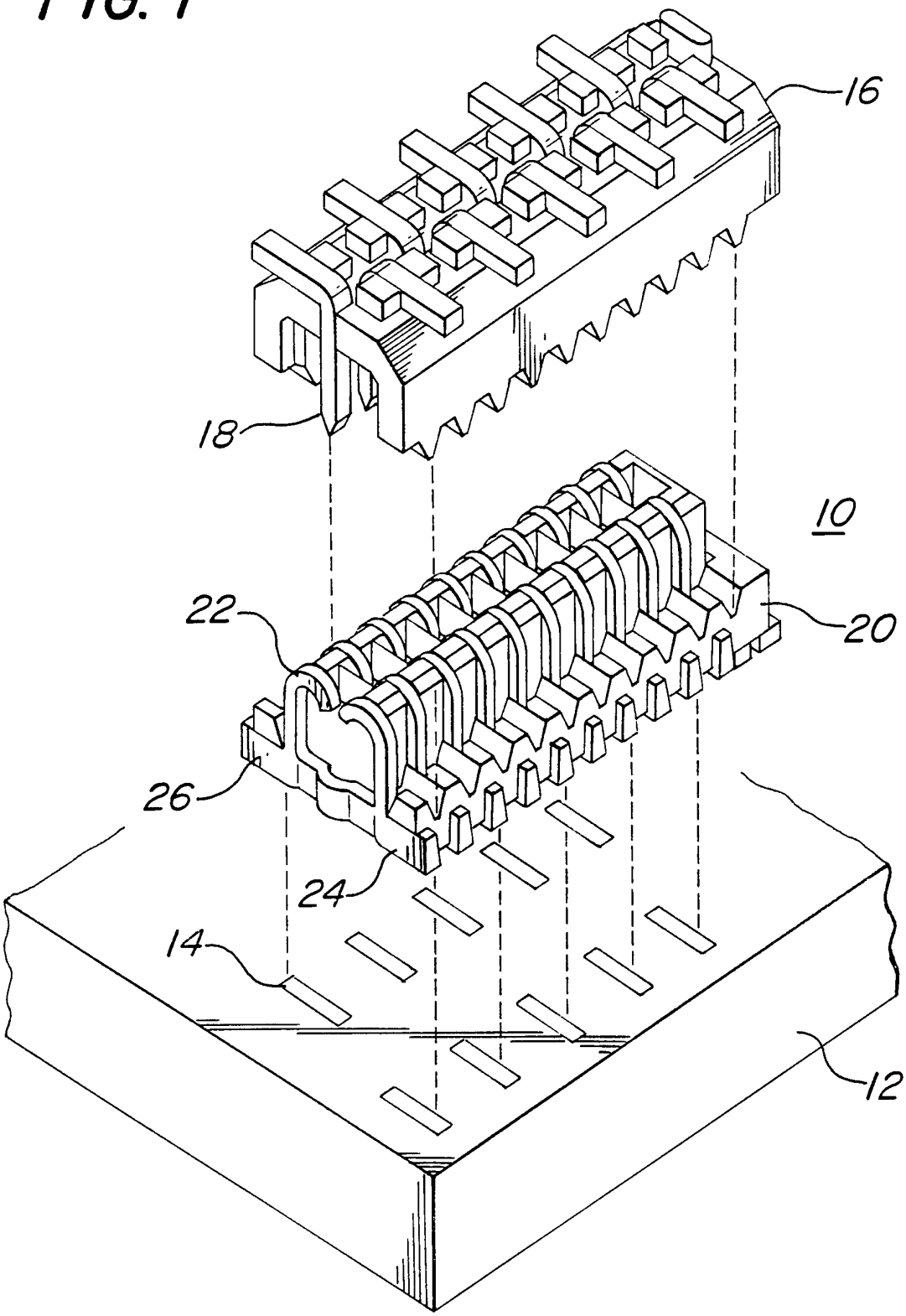


FIG. 2

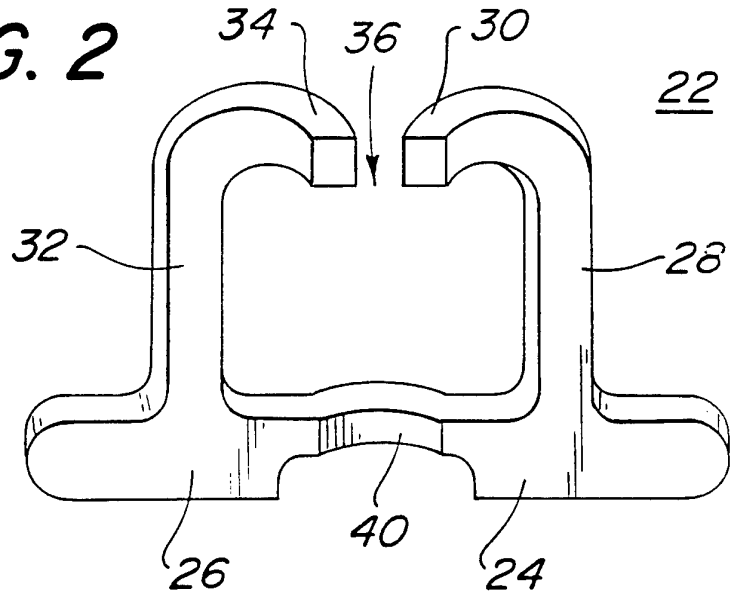
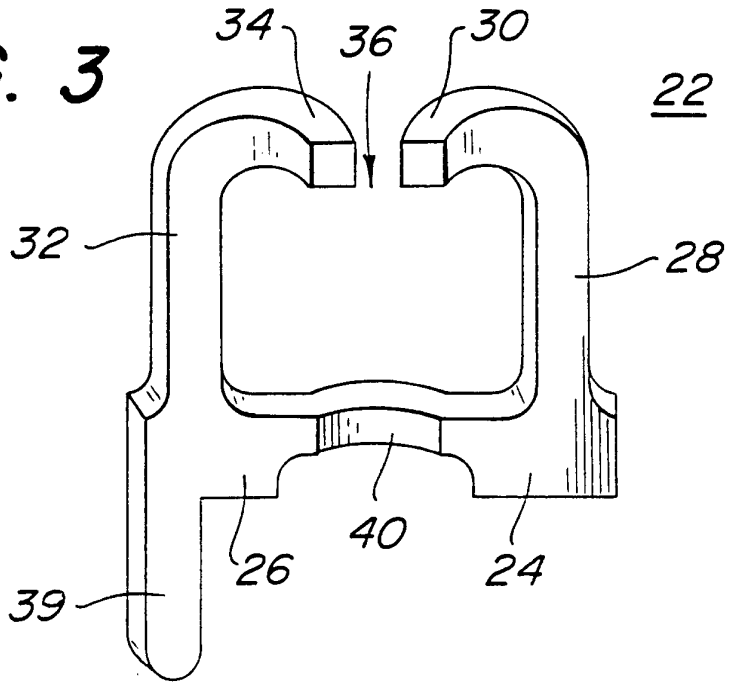


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/14411

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H01R 13/115
US CL :439/857; 29/874
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)

U.S. : 439/857, 62, 65, 83, 636, 660, 682, 856; 29/874, 882

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

NONE

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

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,503,036 (DESSO ET AL.) 24 March 1970 See entire document	1-11
A	US, A, 3,864,004 (FRIEND) 04 February 1975 See entire document	1-11
A	US, A, 4,183,611 (CASCIOTTI ET AL.) 15 January 1980 See entire document	1-11
A	US, A, 4,781,611 (LEONARD) 01 November 1988 See entire document	1-11
A	US, A, 5,013,264 (TONDREAULT) 07 May 1991 See entire document	1-11

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search 30 JANUARY 1995	Date of mailing of the international search report 09 FEB 1995
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Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/14411

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,104,324 (GRABBE ET AL.) 14 April 1992 See entire document	1-11
A	US, A, 5,199,884 (KAUFMAN ET AL.) 06 April 1993 See entire document	1-11

INTERNATIONAL SEARCH REPORT

Int...national application No.
PCT/US94/14411

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/14411

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-7, drawn to an electrical connector/terminal.
Group II, claim(s) 8-11, drawn to a method of making an electrical terminal.
The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the terminal of Group I can be initially molded with the desired size of gap, whereas the terminal of Group II has the gap adjusted after formation of the terminal.