

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 May 2006 (11.05.2006)

PCT

(10) International Publication Number
WO 2006/050203 A1

(51) International Patent Classification:

H01R 12/08 (2006.01) **H01R 12/24** (2006.01)
G06K 7/00 (2006.01)

(21) International Application Number:

PCT/US2005/039148

(22) International Filing Date: 27 October 2005 (27.10.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

200420117685.X
1 November 2004 (01.11.2004) CN

(71) Applicant (for all designated States except US): **MOLEX INCORPORATED** [US/US]; 2222 Wellington Court, Lisle, IL 60532 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **SUN, Zhao, You** [CN/CN]; Rm 1404, N°4, Lane 370, Jin Yang Xin Cun, Shanghai 200135 (CN).

(74) Agent: **WEISS, Stephen, Z.**; Molex Incorporated, 2222 Wellington Court, Lisle, IL 60532 (US).

(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, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

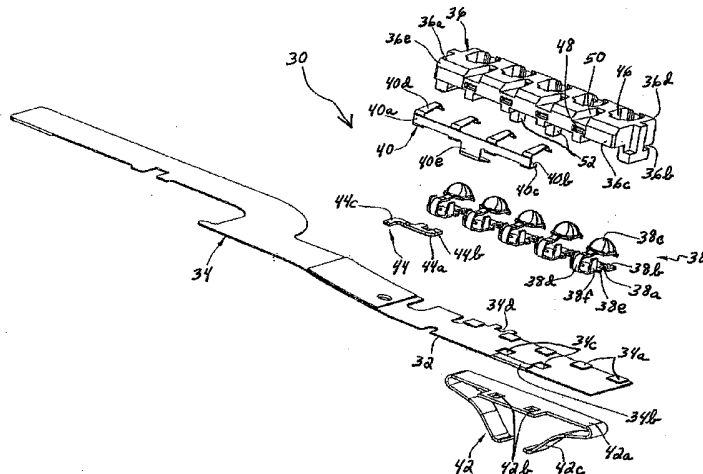
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, 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
- with amended claims

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

(54) Title: ELECTRICAL CONNECTOR SYSTEM FOR FLEXIBLE CIRCUIT BOARDS



(57) Abstract: An electrical connector system is provided for terminating an end of a flexible circuit board. A dielectric connector body has an upper mating face and a lower board mounting face. A fixing portion projects from the lower board mounting face and a fastening portion at the lower board mounting face is spaced from the fixing portion. A plurality of terminals are mounted on the dielectric connector body and have contact portions exposed at the upper mating face of the body for engaging appropriate terminals of a mating connector. Terminating portions of the terminals at the lower board mounting face are connected to appropriate circuit pads on the flexible circuit board. A support member sandwiches the flexible circuit board between the support member and the lower board mounting face of the body. The fixing portion of the body fixes the flexible circuit board and support member to the body. The fastening portion of the body fastens the flexible circuit board to the body spaced from and independent of the fixing portion.

WO 2006/050203 A1

ELECTRICAL CONNECTOR SYSTEM FOR FLEXIBLE CIRCUIT BOARDS

Field of the Invention:

This invention generally relates to the art of electrical connectors and, particularly, to an electrical connector system for terminating an end of a flexible circuit board.

Background of the Invention:

Some electrical connectors are used for termination to an end of a flexible circuit board whereby the circuit board can be electrically connected to a mating connector. For example, flexible circuits are used in mobile telephones whereby the circuit board can be flexed repeatedly during use of the phone. A problem often is encountered when excessive forces are applied to the flexible circuit board. Repeated or excessive forces on the flexible circuit can cause the circuit to pull away from the terminating connector and damage or destroy the electrical connections to the board.

For example, FIG. 1 shows an electrical connector system, generally designated 10, for a mobile phone. An electrical connector, generally designated 12, is terminated to an end of a flexible printed circuit, generally designated 14. The connector includes a dielectric body 16 and an elastic support member, generally designated 18, which sandwiches an end of the flexible circuit board between a flat face 20 of the body and the elastic support member. The dielectric body has a pair of fixing posts 22 which project through holes in the flexible circuit board and through holes 24 in the support member. The posts are thermally melted to fix the support member to the dielectric body, sandwiching the end of the flexible circuit board therebetween. The flexible circuit is bent, as at 26, near the dielectric body. There is no fixing means near the bent area of the flexible circuit board.

During continuous use of the mobile phone in the electrical connector system of FIG. 1, twisting and pulling forces cause the flexible circuit board 14 to separate from dielectric body 16 and support member 18, particularly in the area of the bent portion 26 of the flexible circuit board. The electrical terminating and connecting stability of the system is degraded and the performance of the mobile phone is damaged or destroyed. The present invention is directed to solving these problems.

Summary of the Invention:

An object, therefore, of the invention is to provide a new and improved electrical connector system for terminating an end of a flexible circuit board.

In the exemplary embodiment of the invention, a dielectric connector body has an upper mating face and a lower board mounting face. A fixing portion projects from the lower board mounting face and a fastening portion at the lower board mounting face is spaced from the fixing portion. A plurality of terminals are mounted on the dielectric connector body and have contact portions exposed at the upper mating face of the body for engaging appropriate terminals of a mating connector. Terminating portions of the terminals at the lower board mounting face are connected to appropriate circuit pads on the flexible circuit board. A support member sandwiches the flexible circuit board between the support member and the lower board mounting face of the body. The fixing portion of the body fixes the flexible circuit board and support member to the body. The fastening portion of the body fastens the flexible circuit board to the body spaced from and independent of the fixing portion.

According to one aspect of the invention, the fixing portion of the body comprises a plurality of fixing posts projecting from the lower board mounting face of the body through openings in the flexible circuit board and the support member. In the preferred embodiment, the fixing posts are thermally melted to fix the support member and circuit board to the body. The support member preferably comprises an elastic support member.

According to another aspect of the invention, the fastening portion of the body comprises a fastening post projecting through an opening in the flexible circuit board. In the preferred embodiment, the fastening post is thermally melted for fastening the flexible circuit board to the body.

According to a further aspect of the invention, a fastening member is spaced from and independent of the support member. The fastening post projects from the body through the flexible circuit board and is fixed to the fastening member, as by thermal welding.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

Brief Description of the Drawings:

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages

thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. 1 is a sectioned perspective view of a mobile phone incorporating a connector system according to the prior art;

FIG. 2 is a side elevational view of a connector system according to a first embodiment of the invention;

FIG. 3 is an exploded perspective view of the connector system of the invention;

FIG. 4 is a bottom perspective view of the connector body;

FIG. 5 is a bottom plan view of the connector system of the invention; and

FIG. 6 is a perspective view of another embodiment of the invention.

Detailed Description of the Preferred Embodiments:

Referring to the drawings in greater detail, and first to FIGS. 2-5, the invention is incorporated in an electrical connector system, generally designated 30, for terminating an end 32 of a flat flexible circuit board, generally designated 34. As best seen in FIG. 3, the system includes a dielectric connector body, generally designated 36; a plurality of conductive terminals, generally designated 38, mounted on the body; a grounding element, generally designated 40, mounted on the body; an elastic support member, generally designated 42, for fixing the flexible circuit board to the body; and a fastening member, generally designated 44, for fastening the flexible circuit board to the body spaced from and independent of support member 42.

Referring to FIG. 4 in conjunction with FIGS. 1-3 and 5, and particularly in conjunction with FIG. 3, connector body 36 is a one-piece structure molded of dielectric material such as meltable plastic or the like. Before proceeding further, it should be understood that such terms as “upper”, “lower”, “top”, “bottom” and the like herein and in the claims hereof are used solely for providing a clear and concise understanding of the invention as depicted in the drawings. Obviously, the connector system of the invention is omni-directional in manufacture, assembly and use, particularly when used in such applications as mobile phones and the like.

With those understandings, connector body 36 has an upper mating face 36a, a lower board mounting face 36b, a front face 36c and a rear face 36d as viewed in the drawings. The body is elongated, and a chamfered edge 36e extends longitudinally at a corner of the body

between upper mating face 36a and front face 36c. A plurality of terminal-receiving passages 46 extend vertically through the body. A plurality of receiving slots 48 extend through front face 36c into the body. A plurality of grooves 50 are spaced along the body and open at the upper and front faces thereof. A pair of fixing posts 52 project downwardly from the lower board mounting face 36b of the body. Finally, a fastening post 54 also projects downwardly from the lower board mounting face of the body and is spaced outwardly therefrom by a small arm 54a which is integral with the body and best seen in FIG. 4.

Terminals 38 of connector system 30 maybe stamped and formed of conductive sheet metal material. Each terminal includes a base 38a having a solder tail portion 38b offset downwardly from the base and a dome-shaped contact portion 38c spaced above the base by a generally U-shaped bent portion 38d of the terminal. Teeth 38e are formed at opposite edges of the base, and a pair of mounting tabs 38f project upwardly from the base. Terminals 38 are mounted within the terminal-receiving passages 46 of connector body 36, and teeth 38e and mounting tabs 38f facilitate mounting the terminals in the passages. Solder tail portions 38b are offset downwardly from the bases of the terminals so that the solder tail portions are exposed at the lower board mounting face 36b of the connector body for solder connection to appropriate circuit pads on flexible circuit board 34 as described hereinafter.

Grounding member 40 of electrical connector system 30 filters interference and surrounding noise from the electrical connections of system 30. The grounding element may be stamped and formed of conductive sheet metal material. The grounding element includes an elongated strip 40a which abuts against front face 36c of connector body 36. The grounding element is mounted to the body by means of a plurality of mounting tabs 40b which are inserted into receiving slots 48 in front face 36c of the body. Teeth 40c are stamped at opposite edges of mounting tabs 40b for skiving into the plastic material within slots 48 to secure the grounding element to the body. When so mounted, grounding element 40 has a plurality of grounding fingers 40d disposed within grooves 50 in the upper mating face 36a of the body. A solder tail 40e projects downwardly from the grounding member and is exposed at the bottom of the body for connection to an appropriate grounding pad on flexible circuit board 34 as described hereinafter. Grounding fingers 40d of the grounding element are flexible and can flex within grooves 50 of the body. The grounding members project at least slightly above the upper mating face 36a of the body for engaging an appropriate grounding member of the mating connector.

Flexible circuit board 34 includes a plurality of circuit pads 34a for connection, as by soldering, to the solder tail portions 38b of terminals 38. The flexible circuit board has a ground pad 34b for connection, as by soldering, to the solder tail 40e of grounding element 40. The flexible circuit board has a pair of openings or fixing holes 34c for receiving fixing posts 52 of connector body 36. The flexible circuit board has an opening or fastening notch 34d for receiving fastening post 54 of the connector body.

Elastic support member 42 of electrical connector system 30 is stamped and formed of elastic or spring sheet metal material. The support member has a flat plate portion 42a which is provided with a pair of fixing openings or holes 42b through which fixing post 52 of connector body 36 project. A pair of spring arms 42c project inwardly from opposite ends of the flat plate portion 42a, underlying and spaced from the flat plate portion.

Fastening member 44 has a flat plate portion 44a which is generally F-shaped and includes a fixing opening or fastening notch 44b at one side thereof. The fastening member is stamped or formed with a bent holding portion 44c.

Electrical connector system 30 is assembled as follows. Terminals 38 and grounding element 40 are mounted in or on connector body 36 as described above. Contact portions 38c of the terminals and grounding fingers 40d of the grounding element project upwardly from the upper mating face 36a of the connector body for engaging appropriate terminals and a grounding member of the mating connector. Solder tail portions 38b of the terminals and solder tail 40e of the grounding element are connected, as by soldering, to circuit pads 34a and ground pad 34b of flexible circuit board 34. The flexible circuit board is positioned against the lower board mounting face 36b of the body by inserting fixing posts 52 of the body through fixing holes 34c of the flexible circuit board. Of course, this is done prior to solder connecting the flexible circuit to terminals 38 and grounding element 40.

Elastic support member 42 is assembled by inserting fixing posts 52 through fixing holes 42b of the support member. The flat plate portion 42a of the support member sandwiches end 32 of the flexible circuit board between the support member and the lower board mounting face 36b of the connector body. The support member is securely fixed in place by thermally melting fixing posts 52 to fix the support member and the flexible circuit board securely to connector body 36.

Fastening member 44 is assembled by placing the flat plate portion 44a of the fastening member against the bottom of flat circuit board 34 and aligning fastening notch 44b of the fastening member with fastening notch 34d of the flat circuit board, and embracing fastening post 54 at the bottom of connector body 36. This sandwiches the flexible circuit board between the fastening member and the lower board mounting face 36d of the connector body. Fastening post 54 then is thermally melted to secure the fastening member and the flexible circuit board against the bottom of the connector body at a point spaced from and independent of support member 42. It can be seen in FIG. 5 that holding portion 44c of the fastening member extends or projects inwardly over an area of the flexible circuit board. Therefore, twisting, pulling and bending forces on the flexible circuit board are absorbed by fastening member 44 to isolate those forces from the circuit board in the area of elastic support member 42. The electrical connections thereby are protected from damage or disengagement.

FIG. 6 shows another embodiment of the invention wherein like reference numerals have been applied to designate like components described above in relation to the first embodiment.

In the second embodiment of FIG. 6, fastening post 54 has an extension 60 which projects inwardly over an area of the flexible circuit board 34. In other words, there is a small gap beneath extension 60, slightly larger than the thickness of the flexible circuit board, in which the circuit board is positioned. Extension 60 absorbs forces on the flexible circuit board and prevents those forces from bending the circuit board in the area of elastic support member 42.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

CLAIMS:

What is claimed is:

1. An electrical connector system for terminating an end of a flexible circuit board, comprising:

a dielectric connector body having an upper mating face and a lower board mounting face, a fixing portion projecting from the lower board mounting face and a fastening portion at the lower board mounting face spaced from the fixing portion;

a plurality of terminals mounted on the dielectric connector body and having contact portions exposed at the upper mating face of the body for engaging appropriate terminals of a mating connector and terminating portions at the lower board mounting face for connection to appropriate circuit pads on the flexible circuit board;

a support member sandwiching the flexible circuit board between the support member and the lower board mounting face of the body;

said fixing portion of the body fixing the flexible circuit board and support member to the body; and

said fastening portion of the body fastening the flexible circuit board to the body spaced from and independent of the fixing portion and support member.

2. The electrical connector system of claim 1 wherein said fixing portion of the connector body comprises a fixing post projecting from the lower board mounting face of the body through the flexible circuit board and fixed to the support member.

3. The electrical connector system of claim 2 wherein said fixing post projects through openings in the flexible circuit board and the support member and is thermally melted to fix the support member and circuit board to the connector body.

4. The electrical connector system of claim 3, including a plurality of said fixing posts.

5. The electrical connector system of claim 1 wherein said support member comprises an elastic support member.

6. The electrical connector system of claim 1 wherein said fastening portion of the connector body comprises a fastening post projecting through an opening in the flexible circuit board.

7. The electrical connector system of claim 6 wherein said fastening post is thermally melted for fastening the flexible circuit board to the connector body.

8. The electrical connector system of claim 1, including a fastening member spaced from and independent of the support member, said fastening portion of the connector body fastening the fastening member to the body with the circuit board sandwiched therebetween.

9. The electrical connector system of claim 8 wherein said fastening portion of the connector body comprises a fastening post projecting through the flexible circuit board and fixed to the fastening member.

10. The electrical connector system of claim 9 wherein said fastening post projects through openings in the flexible circuit board and the fastening member and is thermally melted to fasten the fastening member and circuit board to the connector body.

11. An electrical connector system for terminating an end of a flexible circuit board, comprising:

a dielectric connector body having an upper mating face and a lower board mounting face, at least one fixing post projecting from the lower board mounting face and at least one

5 fastening post projecting from the lower board mounting face spaced from the fixing post;

a plurality of terminals mounted on the dielectric connector body and having contact portions exposed at the upper mating face of the body for engaging appropriate terminals of a mating connector and terminating portions at the lower board mounting face for connection to appropriate circuit pads on the flexible circuit board;

- 10 a support member sandwiching the flexible circuit board between the support member and the lower board mounting face of the body, the support member having a fixing opening; said fixing post projecting from the lower board mounting face of the body through the flexible circuit board and through the fixing opening in the support member and fixing the support member and circuit board to the body; and
- 15 said fastening post of the body fastening the flexible circuit board to the body spaced from and independent of the fixing post and support member.

12. The electrical connector system of claim 11, including a plurality of said fixing posts.

13. The electrical connector system of claim 11 wherein said support member comprises an elastic support member.

14. The electrical connector system of claim 11 wherein said fixing post is thermally melted to fix the support member and circuit board to the connector body.

15. The electrical connector system of claim 11 wherein said fastening post has an extension projecting over the flexible circuit board to fasten the circuit board to the connector body.

16. The electrical connector system of claim 11, including a fastening member spaced from and independent of the support member, said fastening post of the connector body fastening the fastening member to the body with the circuit board sandwiched therebetween.

17. The electrical connector system of claim 16 wherein said fastening post projects through an opening in the flexible circuit board and is fixed to the fastening member.

18. The electrical connector system of claim 17 wherein said fastening post is thermally melted to fasten the fastening member and circuit board to the connector body.

AMENDED CLAIMS

[received by the International Bureau on 04 April 2006 (04.04.2006)]

1. An electrical connector system (30) for terminating an end (32) of a
flexible circuit board (34), comprising:
a dielectric connector body (36) having an upper mating face (36a) and a
lower board mounting face (36b), a fixing portion (52) projecting from the lower board
mounting face and a fastening portion (54) at the lower board mounting face spaced from the
fixing portion;
a plurality of terminals (38) mounted on the dielectric connector body and
having contact portions (38c) exposed at the upper mating face of the body for engaging
appropriate terminals of a mating connector and terminating portions (38b) at the lower board
mounting face for connection to appropriate circuit pads (34a) on the flexible circuit board;
a support member (42) sandwiching the flexible circuit board between the
support member and the lower board mounting face of the body;
said fixing portion (52) of the body fixing the flexible circuit board (34) and
support member (42) to the body (36), said fixing portion comprising a fixing post (52)
projecting from the lower board mounting face (36b) of the body through the flexible circuit
board (34) and fixed to the support member (42); and
said fastening portion (54) of the body fastening the flexible circuit board to
the body spaced from and independent of the fixing portion and support member.

2. (Canceled)

2

3. The electrical connector system of claim 3 wherein said fixing post (52)
projects through openings (34c, 42b) in the flexible circuit board (34) and the support member
(42) and is thermally melted to fix the support member and circuit board to the connector.
body (36).

4. The electrical connector system of claim 3, including a plurality of said
fixing posts (52).

5. The electrical connector system of claim 1 wherein said support member
comprises an elastic support member (42).

6. The electrical connector system of claim 1 wherein said fastening portion of the connector body comprises a fastening post (54) projecting through an opening (34d) in the flexible circuit board (34).

7. The electrical connector system of claim 6 wherein said fastening post (54) is thermally melted for fastening the flexible circuit board (34) to the connector body (36).

8. The electrical connector system of claim 1, including a fastening member (44) spaced from and independent of the support member (42), said fastening portion (54) of the connector body (36) fastening the fastening member to the body with the circuit board (34) sandwiched therebetween.

9. The electrical connector system of claim 8 wherein said fastening portion of the connector body comprises a fastening post (54) projecting through the flexible circuit board (34) and fixed to the fastening member (44).

10. The electrical connector system of claim 9 wherein said fastening post (54) projects through openings (34c, 42b) in the flexible circuit board (34) and the fastening member (42) and is thermally melted to fasten the fastening member and circuit board to the connector body (36).

11. An electrical connector system (30) for terminating an end (32) of a flexible circuit board (34), comprising:

a dielectric connector body (36) having an upper mating face (36a) and a lower board mounting face (36b), at least one fixing post (52) projecting from the lower board mounting face and at least one fastening post (54) projecting from the lower board mounting face spaced from the fixing post;

a plurality of terminals (38) mounted on the dielectric connector body and having contact portions (38c) exposed at the upper mating face of the body for engaging appropriate terminals of a mating connector and terminating portions (38b) at the lower board mounting face for connection to appropriate circuit pads (34a) on the flexible circuit board;

a support member (42) sandwiching the flexible circuit board between the support member and the lower board mounting face of the body, the support member having

a fixing opening (42b);

said fixing post (52) projecting from the lower board mounting face (36b) of the body through the flexible circuit board (34) and through the fixing opening (42b) in the support member (42) and fixing the support member and circuit board to the body; and

said fastening post (54) of the body fastening the flexible circuit board to the body spaced from and independent of the fixing post (52) and support member (42).

12. The electrical connector system of claim 11, including a plurality of said
2 fixing posts (52).

13. The electrical connector system of claim 11 wherein said support member
2 comprises an elastic support member (42).

14. The electrical connector system of claim 11 wherein said fixing post (52)
2 is thermally melted to fix the support member (42) and circuit board (34) to the connector
body (36).

15. The electrical connector system of claim 11 wherein said fastening post
2 (54) has an extension (54a) projecting over the flexible circuit board (34) to fasten the circuit
board to the connector body (36).

16. The electrical connector system of claim 11, including a fastening
2 member (44) spaced from and independent of the support member (42), said fastening post
(54) of the connector body (36) fastening the fastening member to the body with the circuit
4 board (34) sandwiched therebetween.

17. The electrical connector system of claim 16 wherein said fastening post
2 (54) projects through an opening (34d) in the flexible circuit board (34) and is fixed to the
fastening member (44).

18. The electrical connector system of claim 17 wherein said fastening post
2 (54) is thermally melted to fasten the fastening member (44) and circuit board (34) to the
connector body (36).

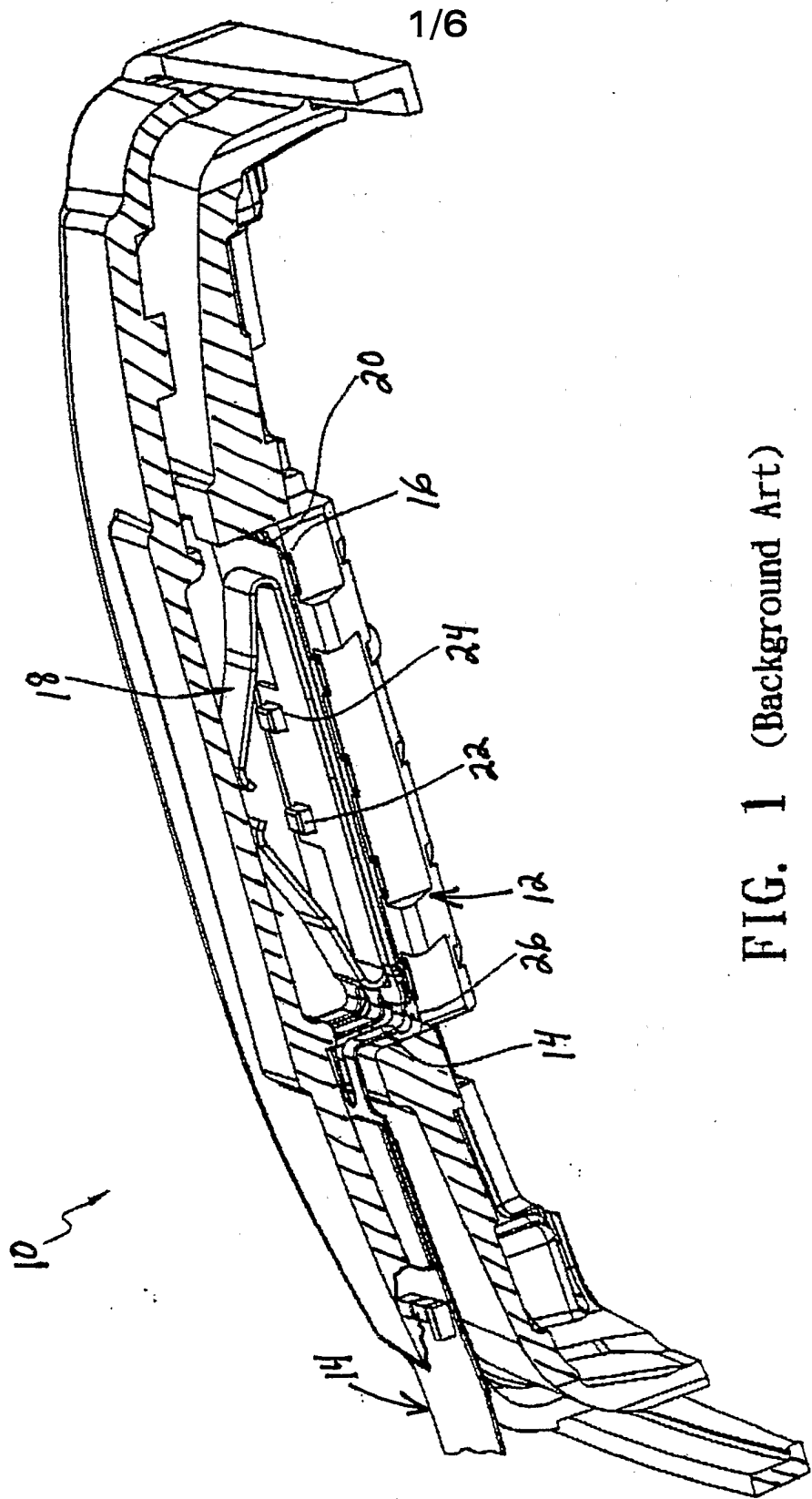


FIG. 1 (Background Art)

2/6

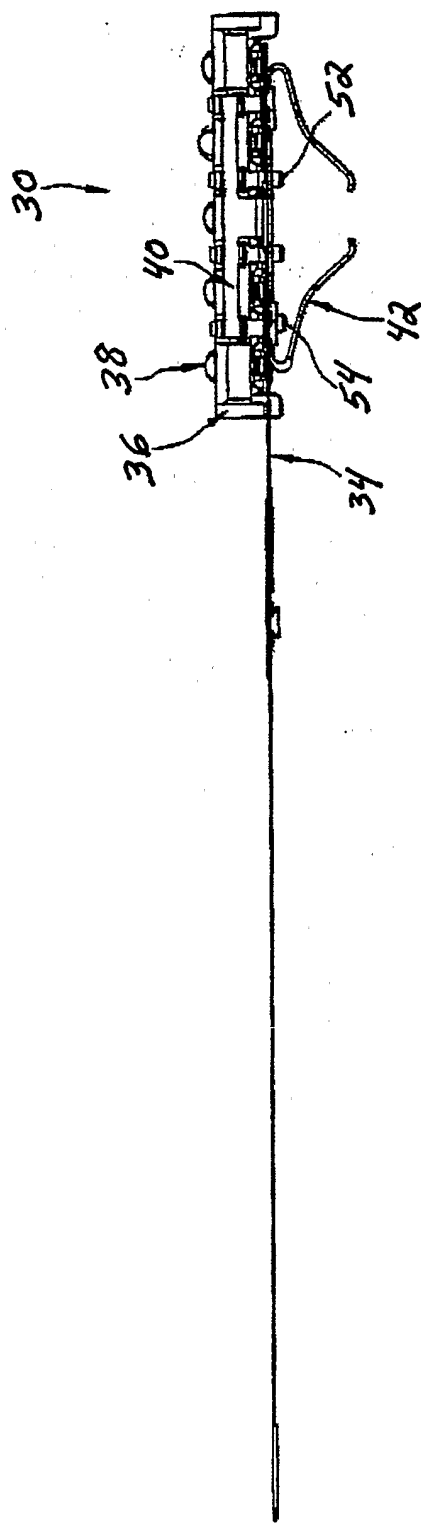


FIG. 2

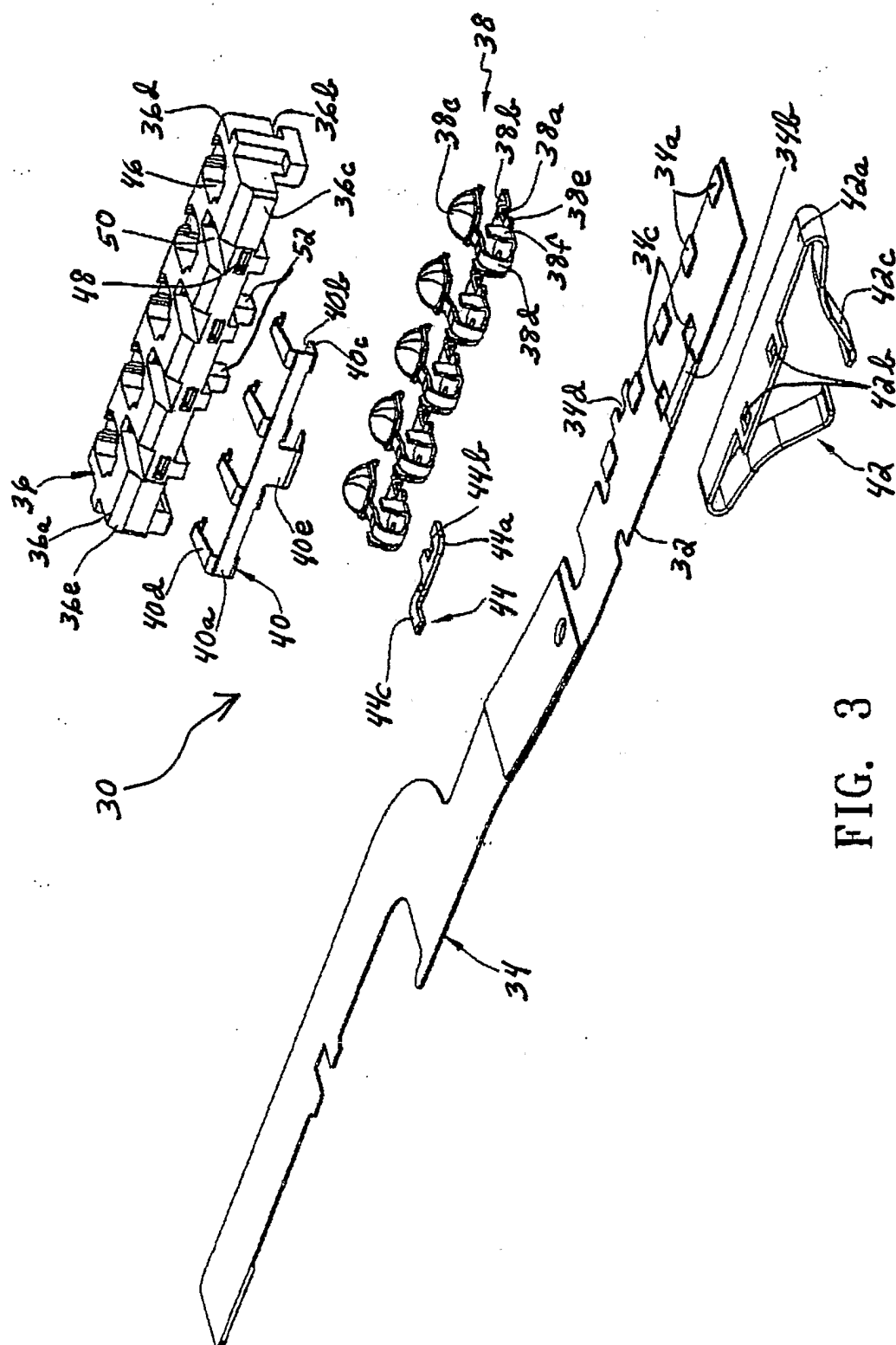


FIG. 3

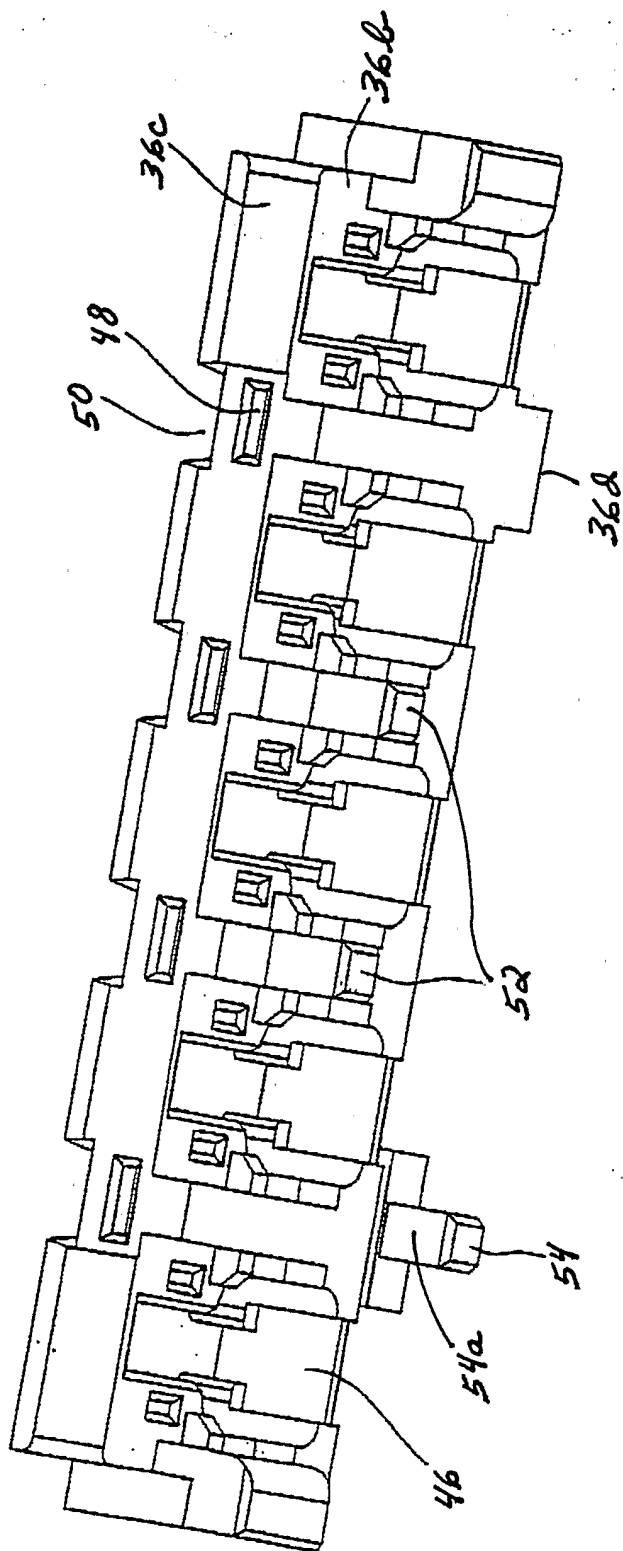


FIG. 4

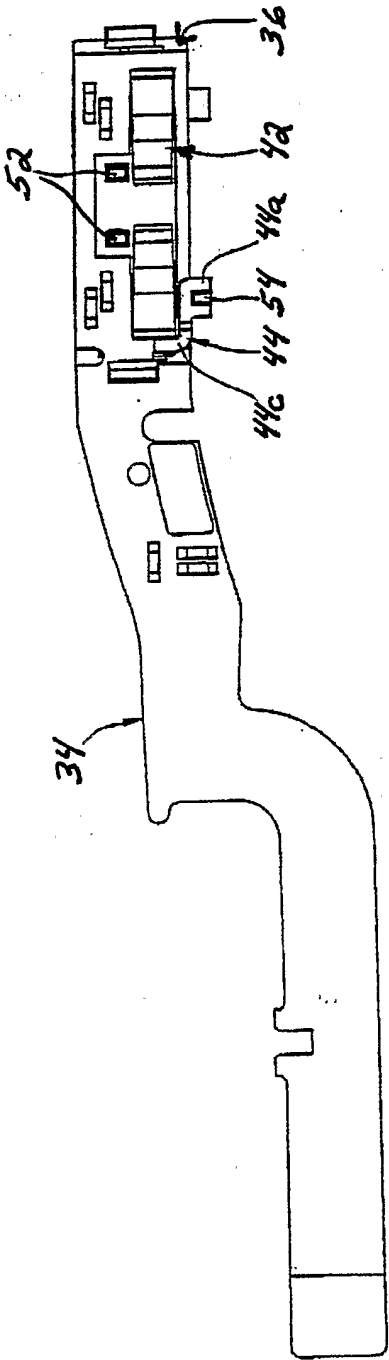


FIG. 5

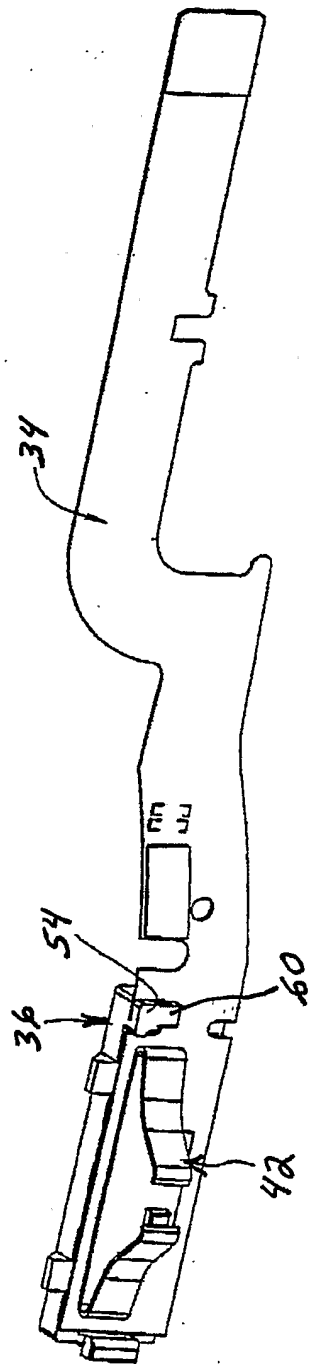


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/039148

A. CLASSIFICATION OF SUBJECT MATTER H01R12/08 G06K7/00 H01R12/24		
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) H01R G06K		
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, WPI Data, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 06, 3 June 2003 (2003-06-03) -& JP 2003 045528 A (ALPS ELECTRIC CO LTD), 14 February 2003 (2003-02-14) abstract; figures 1-6	1
A	DE 44 17 088 A1 (AMPHENOL-TUCHEL ELECTRONICS GMBH, 74080 HEILBRONN, DE; AMPHENOL-TUCHEL) 5 January 1995 (1995-01-05) column 3, line 13 - column 3, line 39; figures 1-3	1-18
A	US 5 161 992 A (BIRCH ET AL) 10 November 1992 (1992-11-10) column 2, line 41 - column 4, line 40; figures 1-3	1-18
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "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 "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 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 20 February 2006		Date of mailing of the international search report 02/03/2006
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Segeberg, T

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2005/039148

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2003045528 A	14-02-2003	CN 1400692 A TW 561649 B	05-03-2003 11-11-2003
DE 4417088 A1	05-01-1995	WO 9427243 A1 EP 0698248 A1 JP 8511114 T US 5726432 A	24-11-1994 28-02-1996 19-11-1996 10-03-1998
US 5161992 A	10-11-1992	NONE	