

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
28 October 2004 (28.10.2004)

PCT

(10) International Publication Number
WO 2004/093260 A1

(51) International Patent Classification⁷: **H01R 13/629**

(74) Agent: CALDWELL, Stacey, E.; Molex Incorporated,
2222 Wellington Court, Lisle, IL 60532 (US).

(21) International Application Number:

PCT/US2004/009318

(22) International Filing Date: 26 March 2004 (26.03.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20-2003-0010042 2 April 2003 (02.04.2003) KR

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

(72) Inventor; and

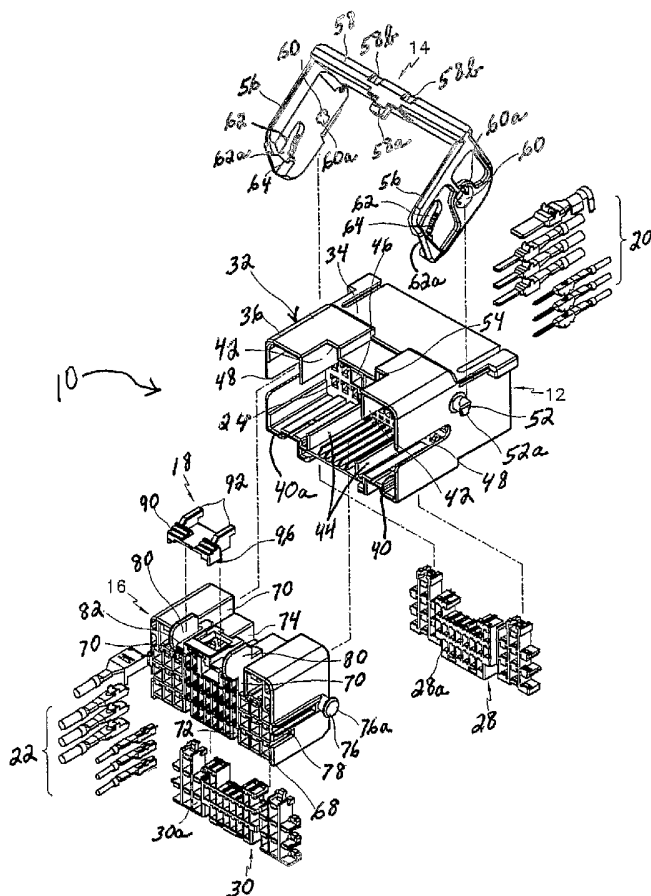
(75) Inventor/Applicant (for US only): **YOON, Byung-Chan** [KR/KR]; 118-1002, Seongwon Apt, Gwangok Maeul, Ha-jong-dong, Siheung-si, Kyunggi-do (KR).

(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, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, 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, 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, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK,

[Continued on next page]

(54) Title: ELECTRICAL CONNECTOR ASSEMBLY WITH MATING ASSIST LEVER



(57) Abstract: A lever type electrical connector assembly includes a first connector having a first dielectric housing mounting a plurality of first terminals. A pair of pivot posts project from opposite sides of the housing. Each pivot post defines a pivot axis and includes a hook projecting radially of the axis at a distal end of the post. A second connector is mateable with the first connector and includes a second dielectric housing mounting a plurality of second terminals for mating with the first terminals of the first connector. A U-shaped mating assist lever defines a pair of lever arms joined by a cross portion. The lever arms are pivotally mounted to opposite sides of the first housing of the first connector by means of pivot holes in the lever arms positioned over the pivot posts. Each pivot hole has a radially extending cut-out in the periphery of the hole for accommodating the radially extending hooks of the pivot posts when the lever arms are mounted to opposite sides of the first housing.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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.

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*

Attorney Reference: A3-363PCT

**ELECTRICAL CONNECTOR
ASSEMBLY WITH MATING ASSIST LEVER**

Field of the Invention:

This invention generally relates to the art of electrical connectors and, particularly, to a connector assembly which includes a pair of mating connectors.

5 Background of the Invention:

Generally, an electrical connector assembly typically includes a first electrical connector mateable with a second electrical connector. For instance, a receptacle connector may receive a plug connector in mated condition. Each connector includes some form of dielectric housing which mounts a plurality of conductive terminals engageable with the
10 terminals of the other connector. For instance, one connector may mount a plurality of socket terminals for receiving pin terminals of the other connector.

In some applications, such electrical connectors mount a rather sizable number of terminals. For instance, in electrically connecting electrical equipment of automobiles or other vehicles, a large number of electrical wires, circuits or other conductive devices lead to
15 and from a large number of fuses, relays, electrical motors, power accessories, and the like, all of which may be mounted in a single electrical connector which, itself, may even include both power terminals and signal terminals. Electrical connectors with such large number of terminals create various problems.

For instance, it is extremely important that the two connectors of the connector
20 assembly be precisely aligned in order to assure that the large number of terminals in the two connectors can be interengaged or mated. Cumulative manufacturing tolerances with large number of terminals, alone, can cause alignment problems. Therefore, the two mating connectors cannot be allowed to twist, turn or shift during mating.

In addition, large forces are required to mate and unmate connectors which have a
25 large number of terminals. Consequently, low-insertion-force connectors have been developed which enable mating and unmating with small forces by means of a latching or mating assist lever which operates through some form of cam groove/cam follower arrangement for drawing the two connectors into mated condition.

Still further, because of external impacts and vibrations imparted on some electrical
30 connectors, such as in automobiles or other vehicles, problems are encountered because the

two mating connectors tend to become unmated, and/or the mating terminals of the two connectors tend to become disengaged. Therefore, it is desirable to provide locking means so that these unmatings or disengagements cannot occur.

The present invention is directed to solving these various problems by providing
5 improvements in such electrical connector assemblies and the mating connectors thereof.

Summary of the Invention:

An object of the invention is to provide a new and improved lever type electrical connector assembly.

10 In the exemplary embodiment of the invention, the assembly includes a first connector having a first dielectric housing mounting a plurality of first terminals. A pair of pivot posts project from opposite sides of the housing. Each pivot post defines a pivot axis and includes a hook projecting radially of the axis at a distal end of the post. A second connector is mateable with the first connector and includes a second dielectric housing
15 mounting a plurality of second terminals for mating with the first terminals of the first connector. A U-shaped mating assist lever defines a pair of lever arms joined by a cross portion. The lever arms are pivotally mounted to opposite sides of the first housing of the first connector by means of pivot holes in the lever arms positioned over the pivot posts. Each pivot hole has a radially extending cut-out in the periphery of the hole for
20 accommodating the radially extending hooks of the pivot posts when the lever arms are mounted to opposite sides of the first housing.

The mating assist lever is operatively associated with the second connector to mate the connectors in response to rotation of the lever. The hooks at the distal ends of the pivot posts prevent the lever arms from coming off of the posts during the rotation of the mating
25 assist lever except when the hooks are aligned with the cut-outs.

Each lever arm of the mating assist lever includes a cam groove therein. The cam groove has a locating detent projection at a given location near a mouth of the groove. The second connector includes a cam follower projection which is positioned through the mouth of the cam groove. The cam follower projection includes a locating detent notch for
30 receiving the detent projection when the mating assist lever is properly positioned for pivotal movement to mate the connectors.

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 perspective view of an electrical connector assembly incorporating the concepts of the present invention;

FIG. 2 is a vertical section taken generally along line 2-2 of FIG. 1;

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

FIG. 4 is a perspective view looking at the mating face of the receptacle connector of the assembly;

FIG. 5 is a side elevational view of the receptacle connector, schematically illustrating the pivotal movement of the latching lever;

FIG. 6 is a perspective view of the locking member detachably mountable on the plug connector;

FIG. 7 is a perspective view of the plug connector;

FIG. 7A is an enlarged depiction of the area encircled at "A" in FIG. 7; and

FIG. 8 is a perspective view of the plug connector of FIGS. 7 and 7A, with the locking member of FIG. 6 mounted thereon.

Detailed Description of the Preferred Embodiment:

Referring to the drawings in greater detail, and first to FIGS. 1-3, the invention is embodied in an electrical connector assembly, generally designated 10, which includes a receptacle connector, generally designated 12, having a latching lever, generally designated 14, pivotally mounted thereon and a plug connector, generally designated 16, having a locking member detachably mounted thereon. Receptacle connector 12 mounts a plurality of conductive pin terminals 20, and plug connector 16 mounts a plurality of socket terminals 22. Pin terminals 20 are mounted in a plurality of terminal-receiving passages 24 (Fig. 2), and socket terminals 22 are mounted in a plurality of terminal-receiving passages 26 (Fig. 2). When the connectors are mated as shown in FIG. 2, socket terminals 26 of plug connector 16 receive pin terminals 20 of receptacle connector 12. The pin and socket terminals may be terminated to a plurality of discrete electrical wires (not shown).

Connector assembly 10 may be used in such applications as automobiles or other vehicles where impacts and vibrations are encountered. Pin and socket terminals 20 and 22, respectively, may be 3V, 5V and 12V terminals, for instance.

Referring to FIG. 3, receptacle member 12 includes a terminal fixing member, generally designated 28, having a plurality of through passages 28a. Plug connector 15 also includes a terminal fixing member, generally designated 30, having a plurality of through passages 30a. Referring to FIG. 2, terminal fixing members 28 and 30 are positioned into internal slots 28b and 30b, respectively, in receptacle connector 12 and plug connector 16, respectively. The terminal fixing members are movable from preliminary, terminal-loading positions to allow terminals 20 and 22 to be inserted into their respective terminal-receiving passages 24 and 26. In the preliminary positions of the terminal fixing members, through passages 28a and 30a are aligned with terminal-receiving passages 20 and 22, respectively, so that the terminals can be fully inserted into their respective passages. Once all of the terminals are fully inserted into their passages, terminal fixing members 28 and 30 are pushed in the direction of arrows "B" to the terminal fixing positions shown in FIG. 2, whereat the terminal fixing members engage shoulders on the terminals to prevent the terminals from being pulled out of their passages.

Referring to FIG. 4 in conjunction with FIG. 3, receptacle connector 12 includes a dielectric housing, generally designated 32, which has a rear body portion 34 and a front mating portion 36. The housing may be a one-piece structure unitarily molded of plastic material. The rear body portion is formed with the terminal-receiving passages 24 within which pin terminals 20 are mounted. Front mating portion 36 defines a receptacle 40 for matingly receiving plug connector 16. Receptacle 40 defined by front mating portion 36 is shaped to conform to the outer profile of plug connector 16 and includes a mating face 40a.

Generally, complementary interengaging guide means are provided between front mating portion 36 of housing 32 of receptacle connector 12 and plug connector 16 for guiding the connectors into mated condition. To that end, a pair of laterally spaced first guide ribs 42 project downwardly into receptacle 40 from a top of the front mating portion 36 of housing 32 of receptacle connector 12. A pair of laterally spaced, second guide ribs 44 project upwardly into receptacle 40 from a bottom of the front mating portion. A third, enlarged guide rib 46 projects downwardly into receptacle 40 from a top of the front mating portion between the first pair of guide ribs 42. The guide ribs extend through the receptacle in the mating direction to rear body portion 34. Still further, a guide slot 48 extends in the mating direction in each of a pair of side walls 50 of front mating portion 36. As seen best in

FIG. 3, a pivot post 52 projects outwardly from each side wall, and each pivot post has a downwardly protruding hook 52a at the distal end thereof. Finally, housing 32 of receptacle connector 12 includes a pair of recesses 54 between first guide ribs 42 and third guide rib 46, for purposes described hereinafter.

5 Latching lever 14 is a mating assist lever and is generally U-shaped to define a pair of latch or lever arms 56 joined by a bight or cross portion 58. A hooked latch projects inwardly from cross portion 58, and a pair of outwardly opening locking grooves 58b are formed in the outside surface of cross portion 58 to form locking shoulders. A pivot hole 60 is formed in
10 each latch or lever arm 56 for receiving a respective latch post 52 projecting outwardly from housing 32. The hole has a radially extending cut-out portion 60a for receiving hook 52a of pivot post 52. Therefore, latching lever 14 can be mounted to housing 32 only by aligning hooks 52a of pivot post 52 with the cut-out areas 60a of pivot holes 60. Once mounted, slight pivotal movement of the latching lever disaligns hook 52a from cut-out 60a, and the latch arms thereafter cannot be disconnected from the housing. Finally, an arcuate cam slot 62 is
15 formed in each lever arm 56 of latching lever 14. The cam slot has an open mouth 62a. A detent projection 64 is formed at a given location in cam slot 62, for purposes described hereinafter. FIG. 5 shows that latching lever 14 is pivotable in the direction of double-headed arrow "C" about pivot posts 52 from a preliminary mating position shown by full lines and a latched or fully mated position shown in phantom, as will be described in greater detail
20 hereinafter.

Referring to FIGS. 7 and 8 in conjunction with FIG. 3, plug connector 16 includes a dielectric housing, generally designated 66, which may be a one-piece structure molded of plastic material. The housing includes the terminal-receiving passages 26 which receive socket terminals 22 (Fig. 3). A pair of first guide grooves 70 in a top portion of the housing
25 receive the first guide ribs 42 of the receptacle connector. A pair of second guide grooves 72 in a bottom portion of housing 66 receive the second guide ribs 44 of the receptacle connector. An enlarged third guide groove 74 receives the third guide rib 36 of the receptacle connector. A cam follower projection or latch post 76 projects outwardly from each opposite side of housing 66. Each latch post has a shank portion 76a and an enlarged head 76b. A
30 locating detent notch 76c is formed in the latch post and faces in the mating direction of the connector. An elongated guide rib 78 extends rearwardly from latch post 76 in the mating direction.

Referring to FIGS. 7 and 7A, a pair of locking member locating walls 80 project upwardly from housing 66 of plug connector 16 for receiving or locating locking member 18

(Fig. 6) in a position shown in FIG. 8. A locking member coupling structure, generally designated 82, is disposed between locating walls 80. The coupling structure includes a locking hole 84 having chamfered first locking shoulders 84a at opposite sides thereof. Another side of the hole defines a latching shoulder 84b. Second locking shoulders 86 are formed near the bottom of locating walls 80.

Referring specifically to FIG. 6, locking member 18 includes a body 90 which may be a one-piece structure molded of plastic material. The body includes a pair of locking projections 92 which extend forwardly in the mating direction. A pair of first mounting hooks 94 project downwardly from the body, and a pair of second mounting hooks 96 also project downwardly from the body but outside first mounting hooks 94. A pair of coupling grooves 98 are formed on the underside of body 90, one groove 98 being disposed outside each first mounting hook 94 and inside the respective second mounting hook 96.

Locking member 18 is mounted to the top of plug connector 16 in the direction of arrow "D" in FIG. 8. When mounted, first mounting hooks 94 on the underside of the locking member snap into latching engagement with the chamfered first locking shoulders 84a (Fig. 7A) of coupling structure 82. Second mounting hooks 96 snap into locking engagement with second locking shoulders 84. Grooves 98 on the underside of the locking member receive coupling projections 100 which project upwardly from coupling structure 82.

The mating of receptacle connector 12 and plug connector 16 and the locking of the connectors in mated condition now will be described. The plug connector is inserted into receptacle 40 of the receptacle connector, as the cam follower projections or latch posts 76 on the outsides of the plug connector are inserted into guide slots 48 in side walls 50 of the receptacle connector. Precise guiding of the plug connector into the receptacle connector is effected as follows: (1) first guide ribs 42 of the receptacle connector move into first guide grooves 70 of the plug connector, (2) second guide ribs 44 of the receptacle connector move into second guide grooves 72 of the plug connector, (3) third guide rib 46 of the receptacle connector moves into third guide groove 74 of the plug connector and (4) elongated guide ribs 78 which trail behind latch post 76 on the plug connector ride into guide slots 48 of the receptacle connector. The elongated guide ribs 78 prevent the two connectors from relative movement in a vertical direction and prevent relative pivoting movement about horizontal axes generally perpendicular to the mating direction. This entire guide means system ensures that the connectors are aligned precisely and, in turn, precisely aligns socket terminals 22 of the plug connector with pin terminals 20 of the receptacle connector.

Further movement of the two connectors in the mating direction causes cam follower projections 76 to enter mouths 62a of cam slots 62 and into the cam slots. Detent projections 64 in the cam slot must be located to enter the locating detent notches 76b in the leading side of latch posts 76 to properly angularly position latching lever 14. This position is shown by full lines of the latching lever in FIG. 5. The latching lever then is pivoted about pivot posts 52 in the direction of arrow "E" (Fig. 5) which pulls the two connectors into final latching position as latch posts 76 of the plug connector ride along cam slots 62 of the rotating latching lever. When the connectors are fully mated, hooked latch 58a (Fig. 4) snaps into latching engagement with latching shoulder 84b (Figs. 7 and 8) of the plug connector to preliminarily latch the latching lever in the mated condition of the connectors.

Separate locking member 18 then is used to completely lock the latching lever in its mated position. This is accomplished by mounting the locking member onto the plug connector in the direction of arrow "D" in FIG. 8, and as described above. When the locking member is so mounted, locking projections 92 of the locking member are positioned in locking grooves 58b of the latching lever so that the latching lever cannot move back out of its final position of mating of the connectors.

Therefore, hooked latch 58a and latching shoulder 84b form a preliminary latch means for mating assist lever 14. Locking member 18 forms a final locking means for the mating assist lever. The preliminary latch means is engaged automatically when the mating assist lever reaches its fully mated position.

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. A lever type electrical connector assembly, comprising:

a first connector including a first dielectric housing mounting a plurality of first terminals, a pair of pivot posts projecting from opposite sides of the housing, each pivot post defining a pivot axis and including a hook projecting radially of the axis at a distal end of the post;

a second connector mateable with the first connector and including a second dielectric housing mounting a plurality of second terminals for mating with the first terminals of the first connector;

a U-shaped mating assist lever defining a pair of lever arms joined by a cross portion, the lever arms being pivotally mounted to opposite sides of the first housing of the first connector by means of pivot holes in the lever arms positioned over said pivot posts, each pivot hole having a radially extending cut-out in the periphery of the hole for accommodating the radially extending hooks of the pivot posts when the lever arms are mounted to opposite sides of the first housing;

said mating assist lever being operatively associated with the second connector to mate the connectors in response to rotation of the lever; and

said hooks at the distal ends of the pivot posts preventing the lever arms from coming off of the posts during said rotation except when the hooks are aligned with said cut-outs.

2. The electrical connector of claim 1 wherein each lever arm of the mating assist lever includes a cam groove therein, the cam groove having a locating detent projection at a given location near a mouth of the groove, and the second connector includes a cam follower projection which is positioned through the mouth of the cam groove, the cam follower projection including a locating detent notch in the periphery thereof for receiving the detent projection when the mating assist lever is properly positioned for pivotal movement to mate the connectors.

3. A lever type electrical connector assembly, comprising:

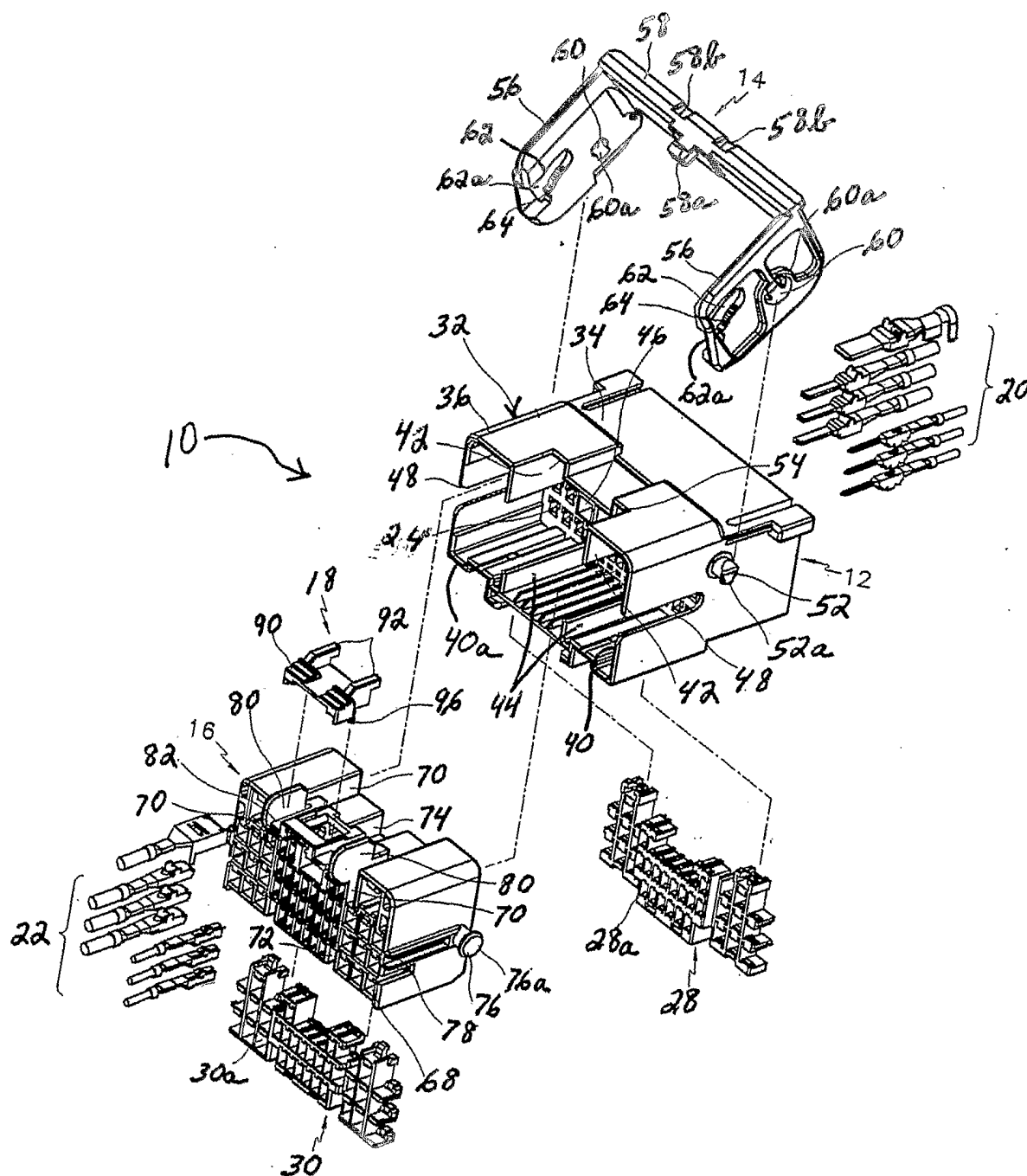
a first connector including a first dielectric housing mounting a plurality of first terminals;

a mating assist lever pivotally mounted on the housing of the first connector for
5 pivotal movement between a preliminary mating position and a fully mated position, the lever
having a cam groove therein, and the cam groove having an open mouth and a locating detent
projection at a location facing the mouth; and

a second connector mateable with the first connector and including a dielectric
housing mounting a plurality of second terminals for mating with the first terminals of the
10 first connector, and a cam follower projection engageable in the cam groove of the mating
assist lever in its preliminary mating position, the cam follower projection including a
locating detent notch in the periphery thereof for receiving the detent projection in the cam
groove when the mating assist lever is properly positioned at the preliminary mating position
whereby the connectors are mated in response to rotation of the lever to its fully mated
15 position as the cam follower projection rides along the cam groove.

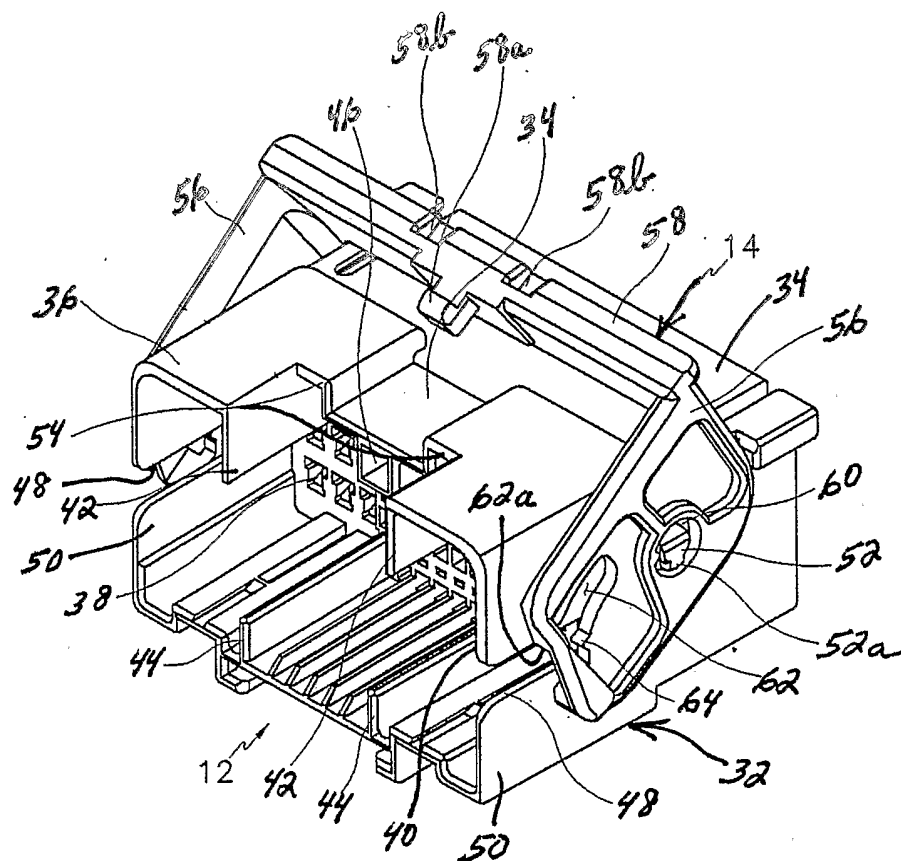
【 FIG. 3 】

2/5

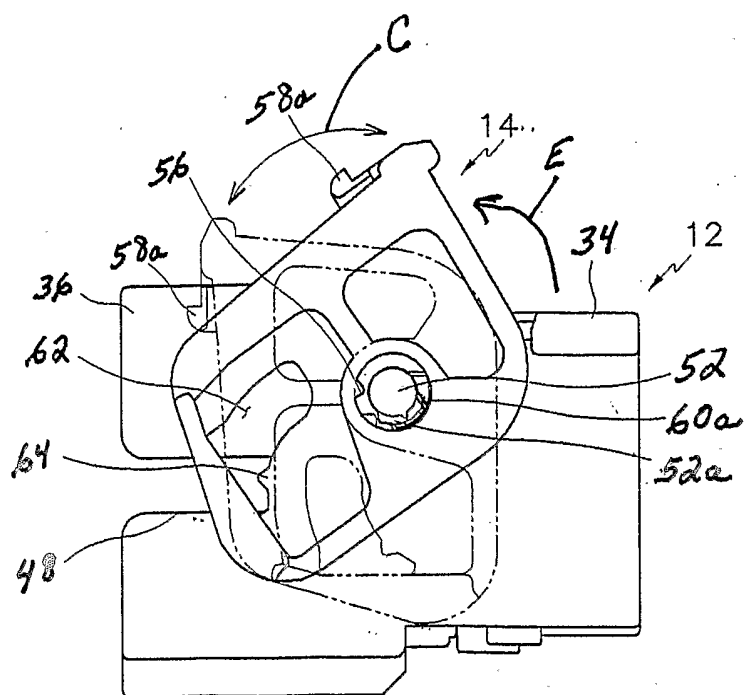


3/5

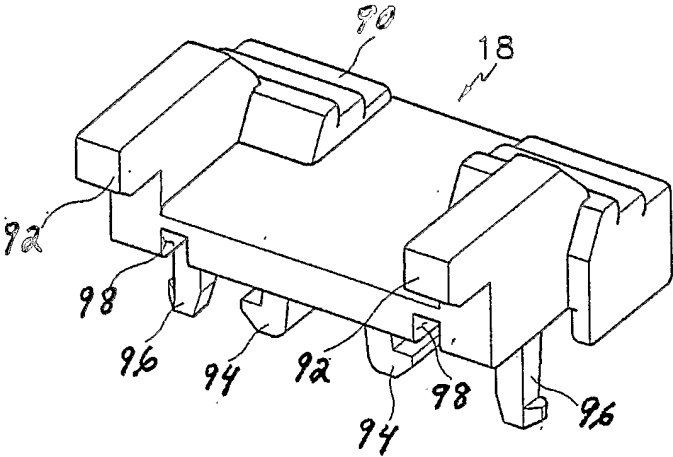
【 FIG. 4 】



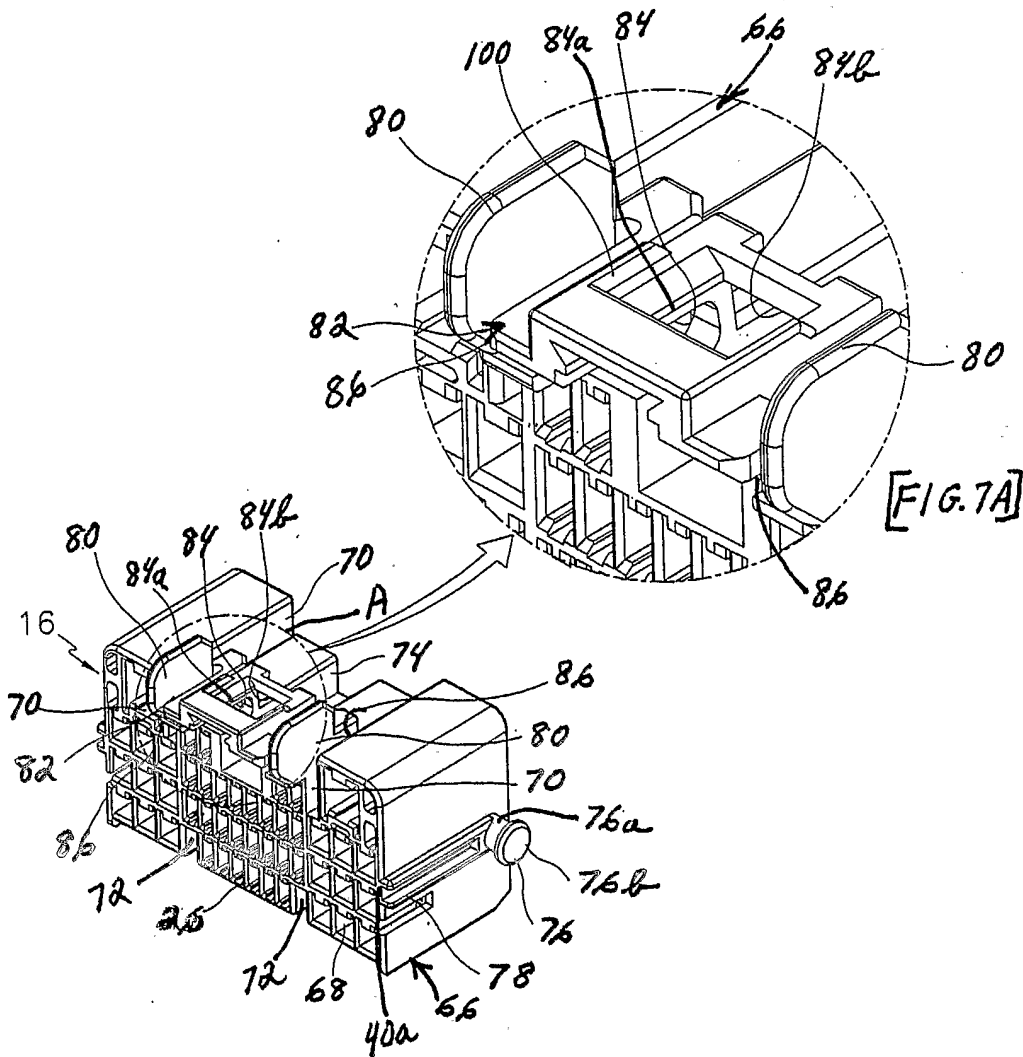
【 FIG. 5 】



[FIG. 6]



[FIG. 7]



INTERNATIONAL SEARCH REPORT

International Application No

T/US2004/009318

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01R13/629

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

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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 646 994 A (SUMITOMO WIRING SYSTEMS) 5 April 1995 (1995-04-05)	1
Y	column 4, line 20 - column 6, line 33 figures 1-3	2
X	US 5 320 544 A (NAOTO TAGUCHI ET AL) 14 June 1994 (1994-06-14)	3
Y	column 4, line 21 - column 6, line 15 figures 1-4	2
X	US 5 797 758 A (ISHIZAKI KAZUHISA ET AL) 25 August 1998 (1998-08-25)	1
	column 3, line 18 - column 5, line 4 figures 1-3	
X	US 6 540 532 B1 (MARTIN GALEN MONROE ET AL) 1 April 2003 (2003-04-01)	1
	column 3, line 24 - column 8, line 1 figures 1-9	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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

11 August 2004

Date of mailing of the international search report

02/09/2004

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

Ledoux, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

CT/US2004/009318

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0646994	A	05-04-1995	JP 2882260 B2	12-04-1999
			JP 7106018 A	21-04-1995
			DE 69411344 D1	06-08-1998
			DE 69411344 T2	28-01-1999
			EP 0646994 A2	05-04-1995
			US 5575671 A	19-11-1996
US 5320544	A	14-06-1994	JP 2634532 B2	30-07-1997
			JP 5290921 A	05-11-1993
US 5797758	A	25-08-1998	JP 3324724 B2	17-09-2002
			JP 9223540 A	26-08-1997
US 6540532	B1	01-04-2003	BR 0205179 A	22-07-2003
			CA 2413911 A1	13-06-2003
			EP 1320150 A2	18-06-2003
			JP 2003197310 A	11-07-2003