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(54) **CONNECTOR**

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H01R 13/648 (2006.01)

(52) **U.S. Cl.** **439/609**; 439/680

(58) **Field of Classification Search** 439/680, 439/681, 677, 607, 609, 610
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,508,756	A		4/1985	Senda et al.
4,567,608	A		1/1986	Watson et al.
4,850,899	A	*	7/1989	Maynard
5,055,069	A	*	10/1991	Townsend et al.
5,080,603	A	*	1/1992	Mouissie
5,104,243	A	*	4/1992	Harding
5,108,313	A	*	4/1992	Adams
5,186,646	A	*	2/1993	Pederson
5,235,217	A		8/1993	Kirton
5,267,881	A		12/1993	Matuzaki
5,277,624	A	*	1/1994	Champion
5,344,335	A		9/1994	Scholz et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1282124	A	1/2001
CN	1368768	A	9/2002
DE	10104288	C1	4/2002
EP	0805523	A2	11/1997
JP	7-176351	A	7/1995
JP	10-321302	A	12/1998
JP	10-334993	A	12/1998
JP	2000-223216	A	6/2000
JP	2000-223215	A	8/2000
JP	2000-223218	A	8/2000
JP	2001-35603	A	2/2001
JP	2001-196133	A	7/2001
JP	2001-230021	A	8/2001
WO	WO 97/39610	A	10/1997

OTHER PUBLICATIONS

Derman, Glenda, "Monitors Make Net Connections", 1996, *Electronic Engineering Times*, vol. 933, pp. 60 and 69.

Lewis, Peter; "On Technology"; 2002, *Fortune Magazine*, p. 240.

"iPodDock/iPod Cradle"; www.bookendz/dock_cradle.htm, downloaded Feb. 27, 2003, 2 pages.

"Neuros MP3 Digital Audio Computer"; www.neurosaudio.com. downloaded Apr. 9, 2003, 6 pages.

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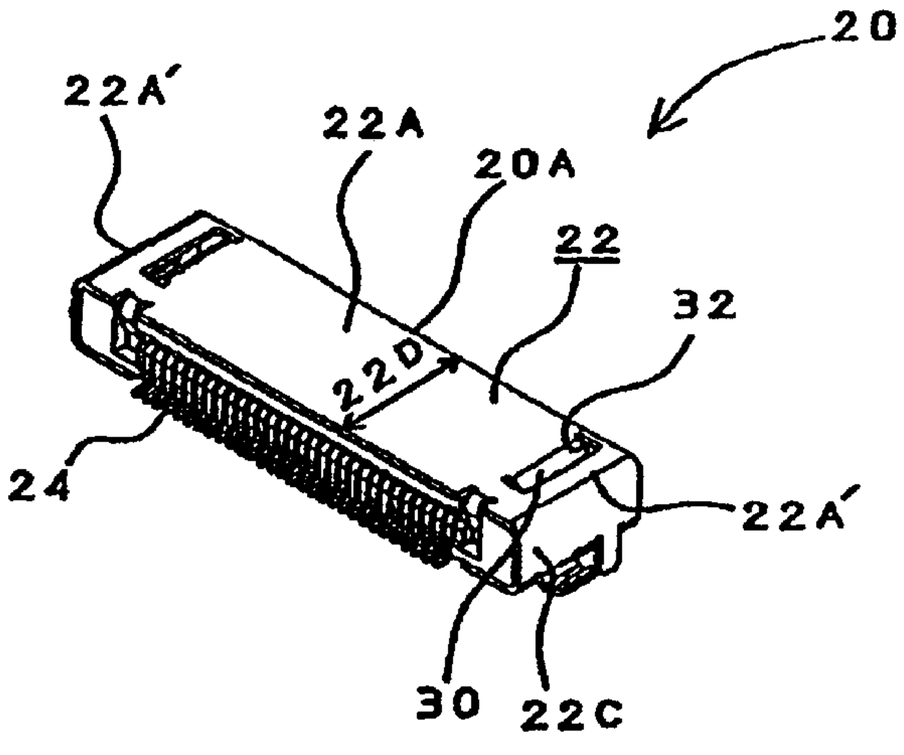
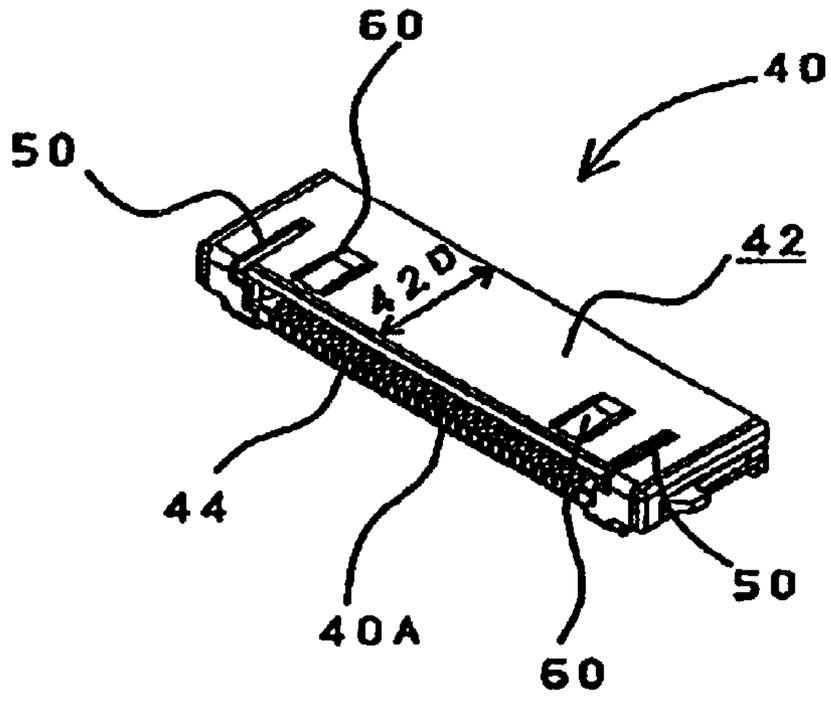
(57) **ABSTRACT**

A connector including a first connector element and a second connector element that are coupled into a single unit, in which the first connector element has an engagement projection that projects interior of the first connector element and extends in the direction of the depth of the first connector element so that the front end of the engagement projection is spacedly apart from the front edge of the first connector element, and the second connector element is formed with an engagement slit that extends in the direction of depth of the second connector element and engages with the engagement projection of the first connector element.

10 Claims, 6 Drawing Sheets





U.S. PATENT DOCUMENTS

5,425,650	A		6/1995	Maeda	
5,586,893	A	*	12/1996	Mosquera	
5,660,558	A	*	8/1997	Osanai et al.	
5,697,817	A		12/1997	Bouchan et al.	
5,830,001	A	*	11/1998	Kinoshita	
5,901,049	A	*	5/1999	Schmidt et al.	
5,975,957	A	*	11/1999	Noda et al.	
5,990,758	A		11/1999	Matsubara	
6,053,773	A	*	4/2000	Wu	
6,116,943	A		9/2000	Ferrill et al.	
6,154,798	A	*	11/2000	Lin et al.	
6,203,345	B1	*	3/2001	Roque et al.	
6,206,480	B1	*	3/2001	Thompson	
6,267,623	B1	*	7/2001	Hisamatsu	
6,319,061	B1	*	11/2001	Chen et al.	
6,322,396	B1	*	11/2001	Kuan	
6,344,727	B1	*	2/2002	Desai et al.	
6,354,713	B1	*	3/2002	Leifer et al.	
6,356,084	B1		3/2002	Levine	
6,358,089	B1	*	3/2002	Kuroda et al.	439/607
6,431,915	B1	*	8/2002	Ko	
6,454,592	B2	*	9/2002	Takagi	
6,461,173	B1	*	10/2002	Mizuno et al.	
6,464,542	B1	*	10/2002	Lee	
6,468,110	B2		10/2002	Fujino et al.	
6,478,603	B1		11/2002	Wu	
6,485,328	B1		11/2002	Wu	
6,524,119	B2		2/2003	Kato et al.	
6,577,877	B1		6/2003	Charlier et al.	
6,585,540	B2		7/2003	Guitierrez et al.	
6,591,085	B1		7/2003	Grady	
6,607,397	B1	*	8/2003	Zhang et al.	439/357
6,608,264	B1		8/2003	Fouladpour	
6,616,473	B2		9/2003	Kamata et al.	
6,619,986	B1	*	9/2003	Yeh	439/607
6,653,813	B2		11/2003	Khatri	
6,728,546	B1		4/2004	Peterson et al.	
6,776,626	B2		8/2004	Huang et al.	
6,776,665	B2		8/2004	Huang	
6,813,528	B1		11/2004	Yang	
6,816,376	B2		11/2004	Bright et al.	
6,840,807	B2	*	1/2005	Ooya et al.	439/630
6,859,854	B2		2/2005	Kwong	
6,991,483	B1		1/2006	Milan et al.	
7,004,787	B2		2/2006	Milan	
2002/0010759	A1	*	1/2002	Hitson et al.	
2002/0029303	A1	*	3/2002	Nguyen	
2002/0065074	A1	*	5/2002	Cohn et al.	
2002/0103008	A1	*	8/2002	Rahn et al.	
2002/0115480	A1	*	8/2002	Haung	
2002/0151327	A1	*	10/2002	Levitt	
2002/0156546	A1	*	10/2002	Ramaswamy	
2003/0002866	A1		1/2003	Tan et al.	
2003/0008553	A1	*	1/2003	Oleynick et al.	439/541.5
2003/0067741	A1		4/2003	Alfonso et al.	
2003/0073432	A1		4/2003	Meade	
2004/0090998	A1		5/2004	Chen	
2004/0186935	A1		9/2004	Bell et al.	
2004/0224638	A1		11/2004	Fadell	
2004/0235339	A1		11/2004	Sato et al.	
2005/0014536	A1		1/2005	Grady	
2005/0227537	A1		10/2005	Peng	
2005/0239333	A1		10/2005	Watanabe et al.	
2006/0001700	A1		1/2006	Bertelsen	
2006/0160429	A1		7/2006	Dawiedczyk et al.	
2006/0292354	A1		12/2006	Miyashita	

* cited by examiner

FIG. 1

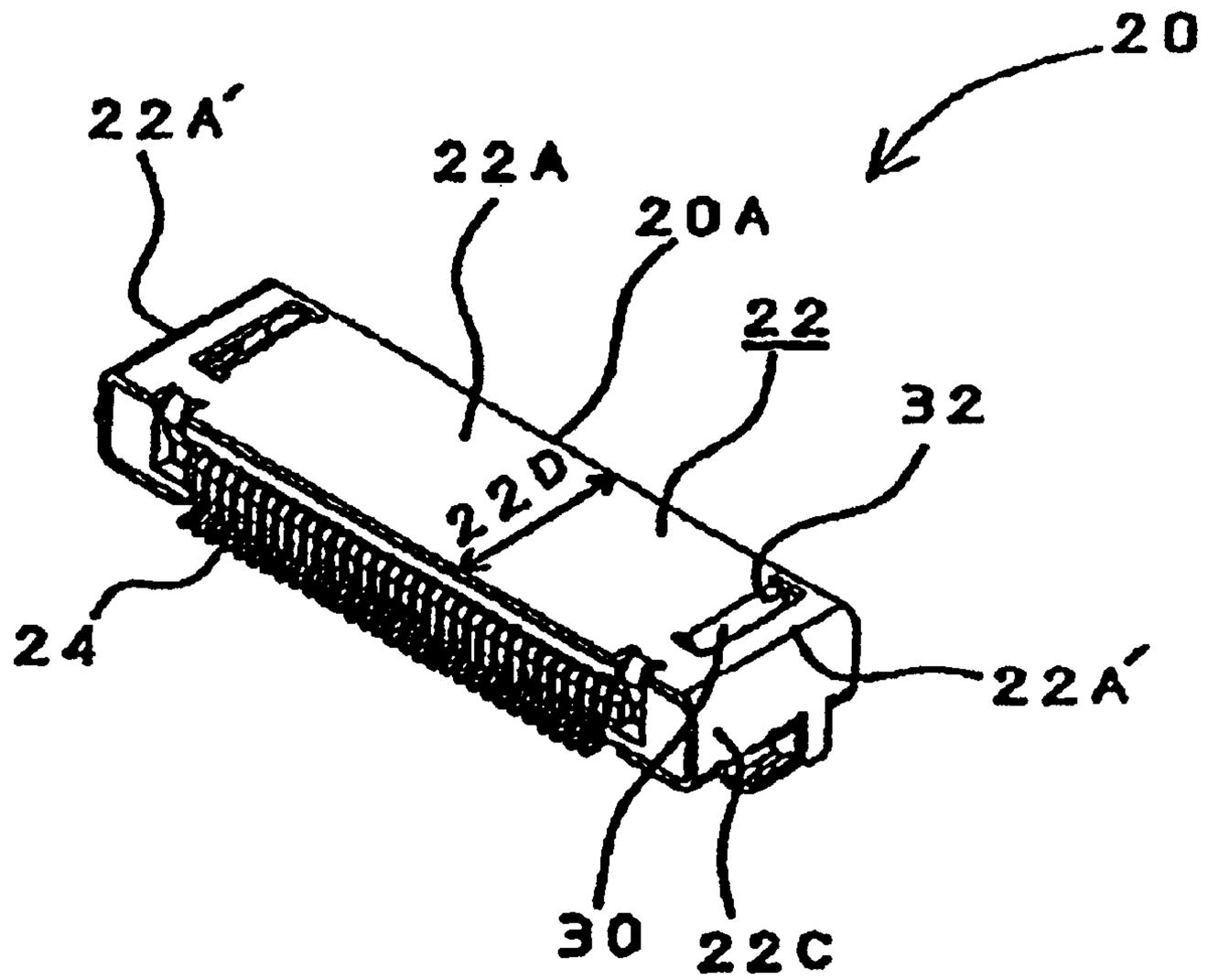


FIG. 2

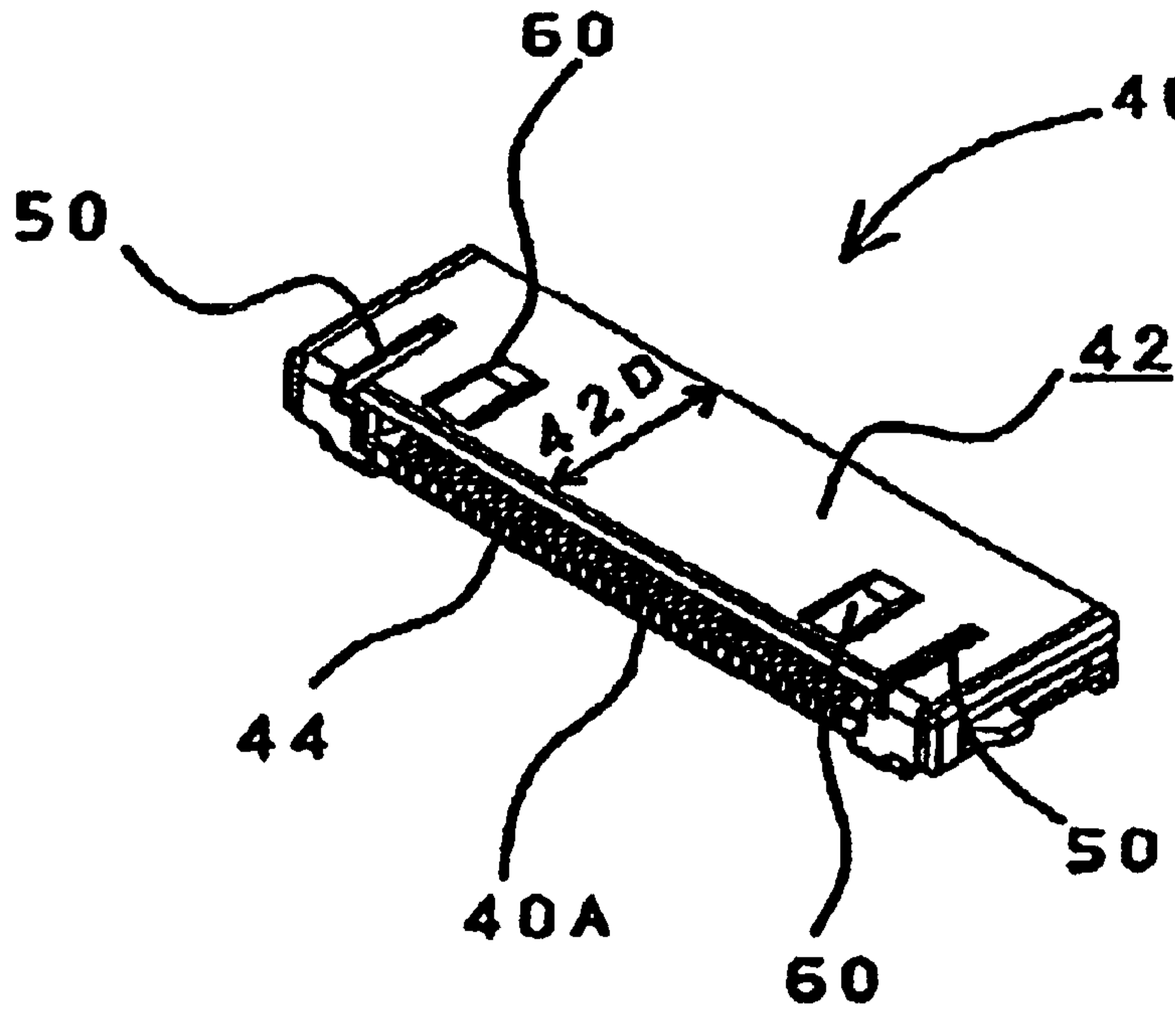


FIG. 3

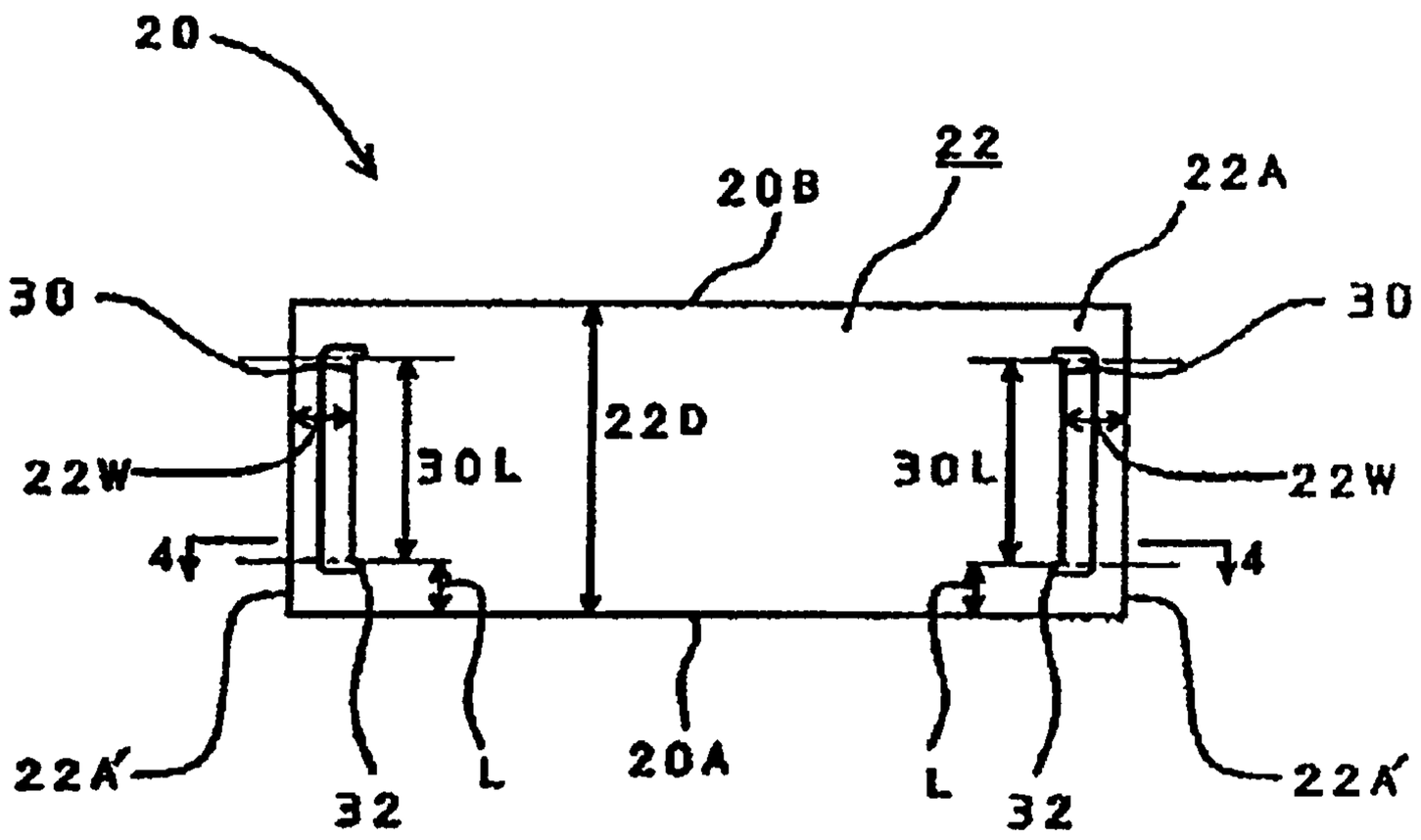


FIG. 4 (Amended)

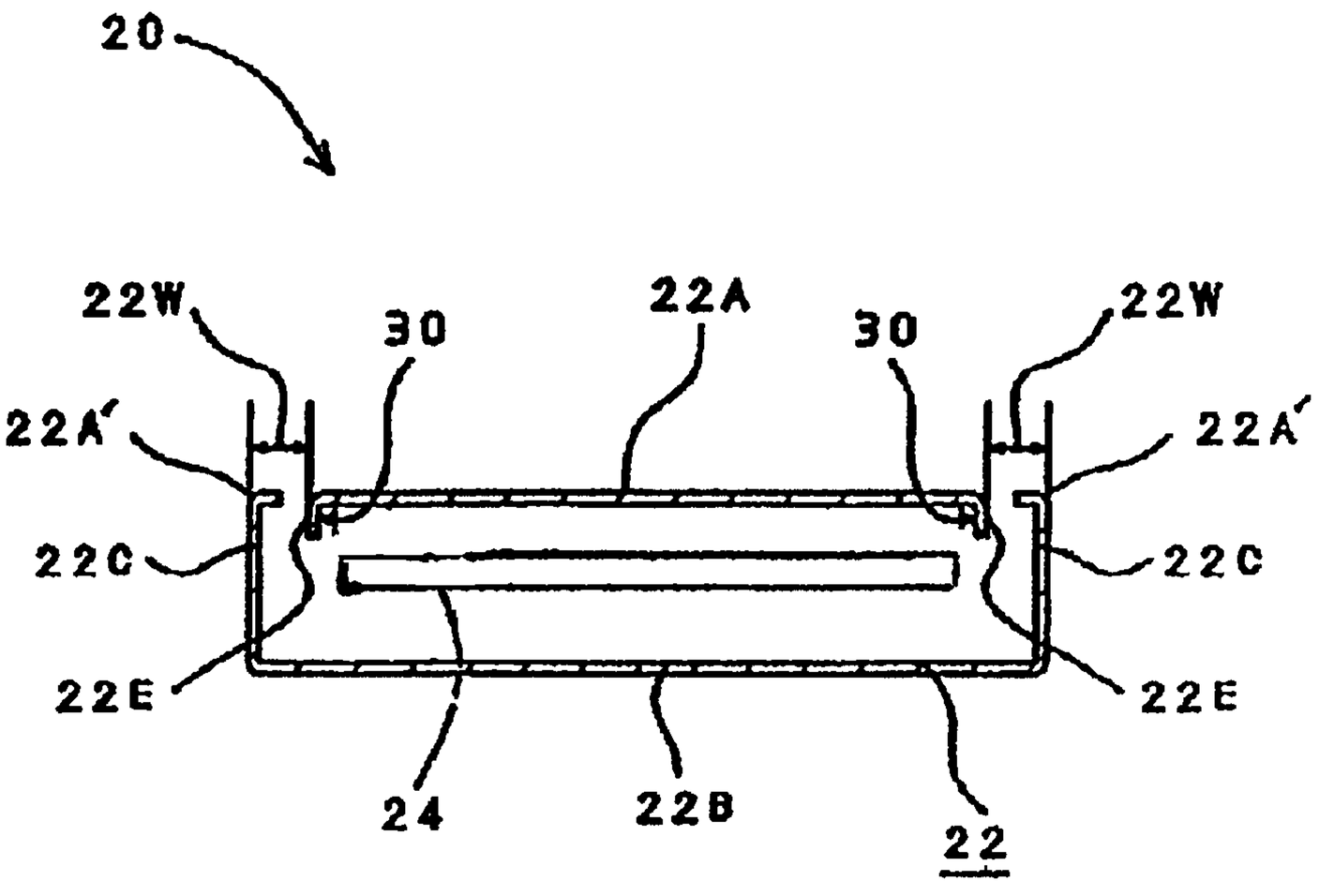


FIG. 5

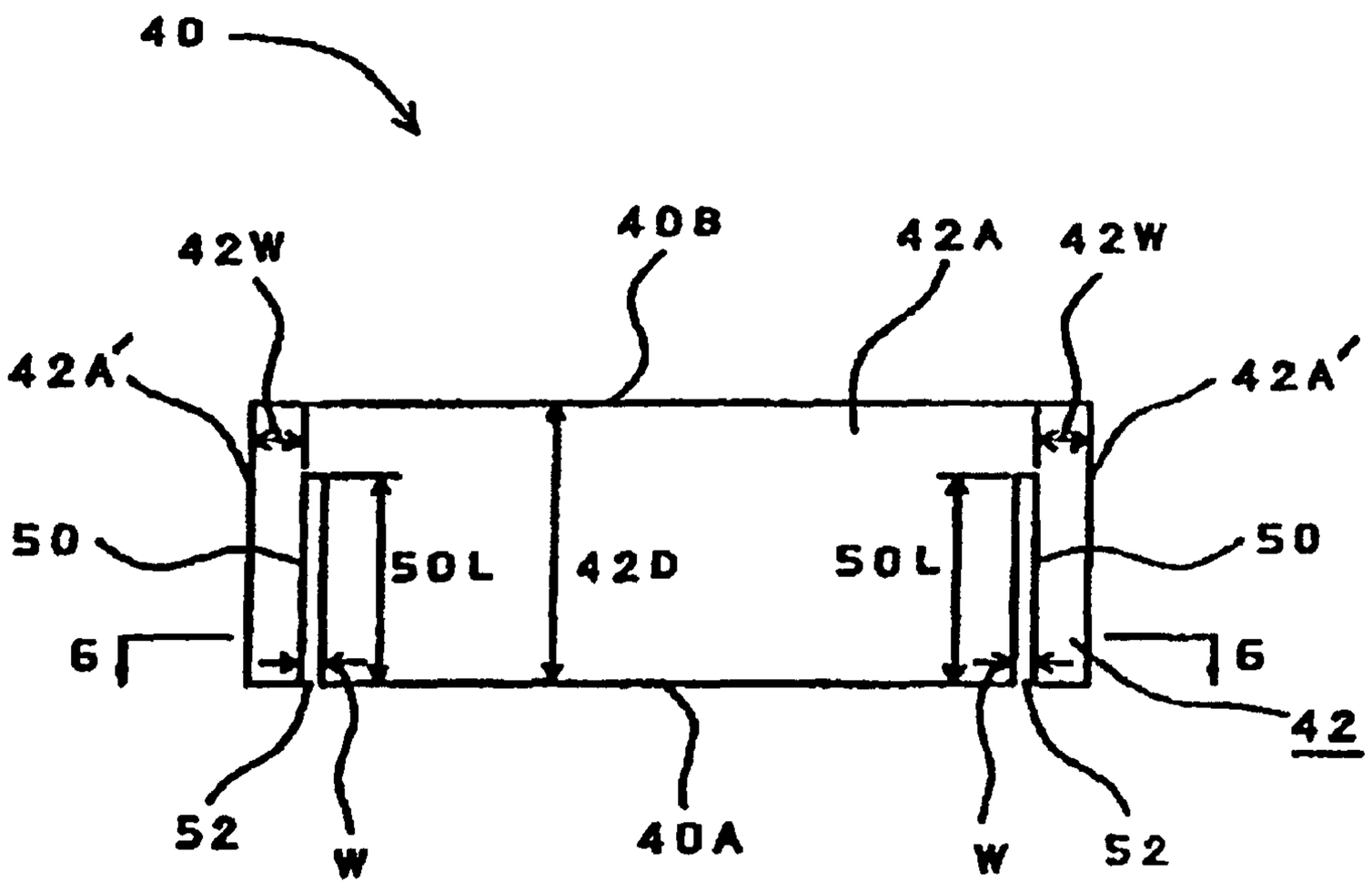

40
42W
40B
42A
42W
42A'
42A'
50
50L
42D
50L
50
6
6
42
52
W
40A
W
52

FIG. 6

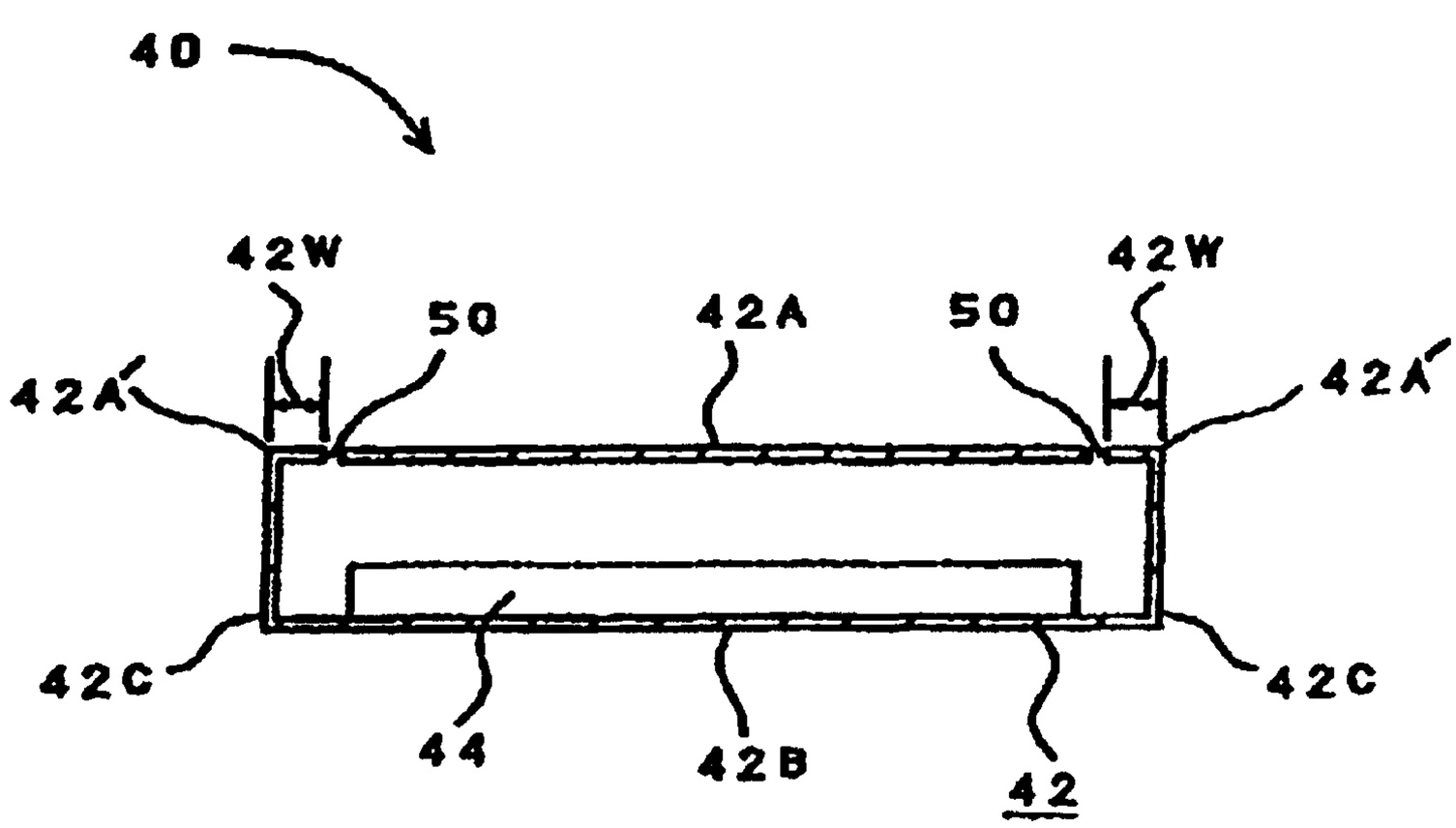

40
42W
50
42A
50
42W
42A'
42A'
42C
42C
44
42B
42

FIG. 7 (Amended)

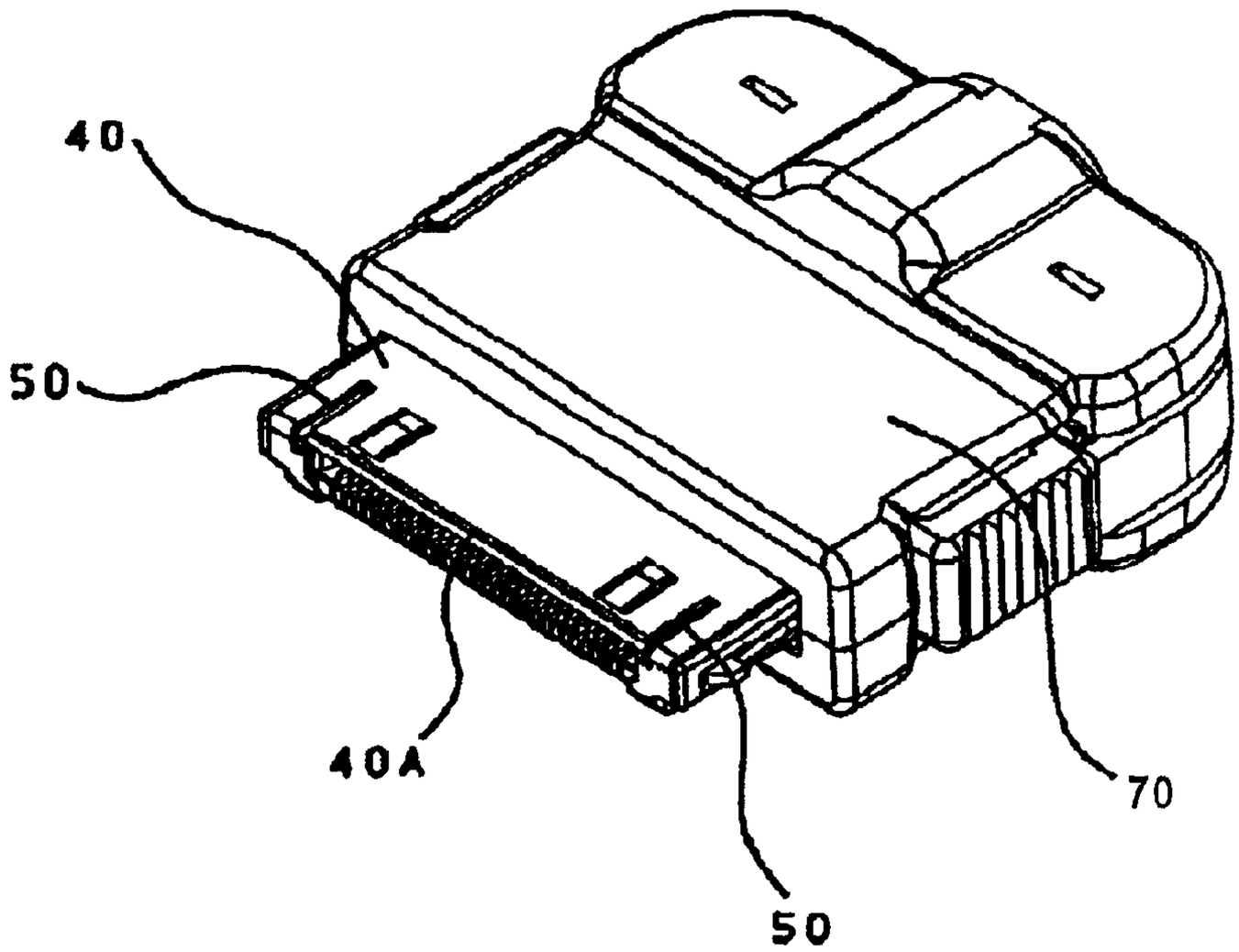


FIG. 9 (Amended)

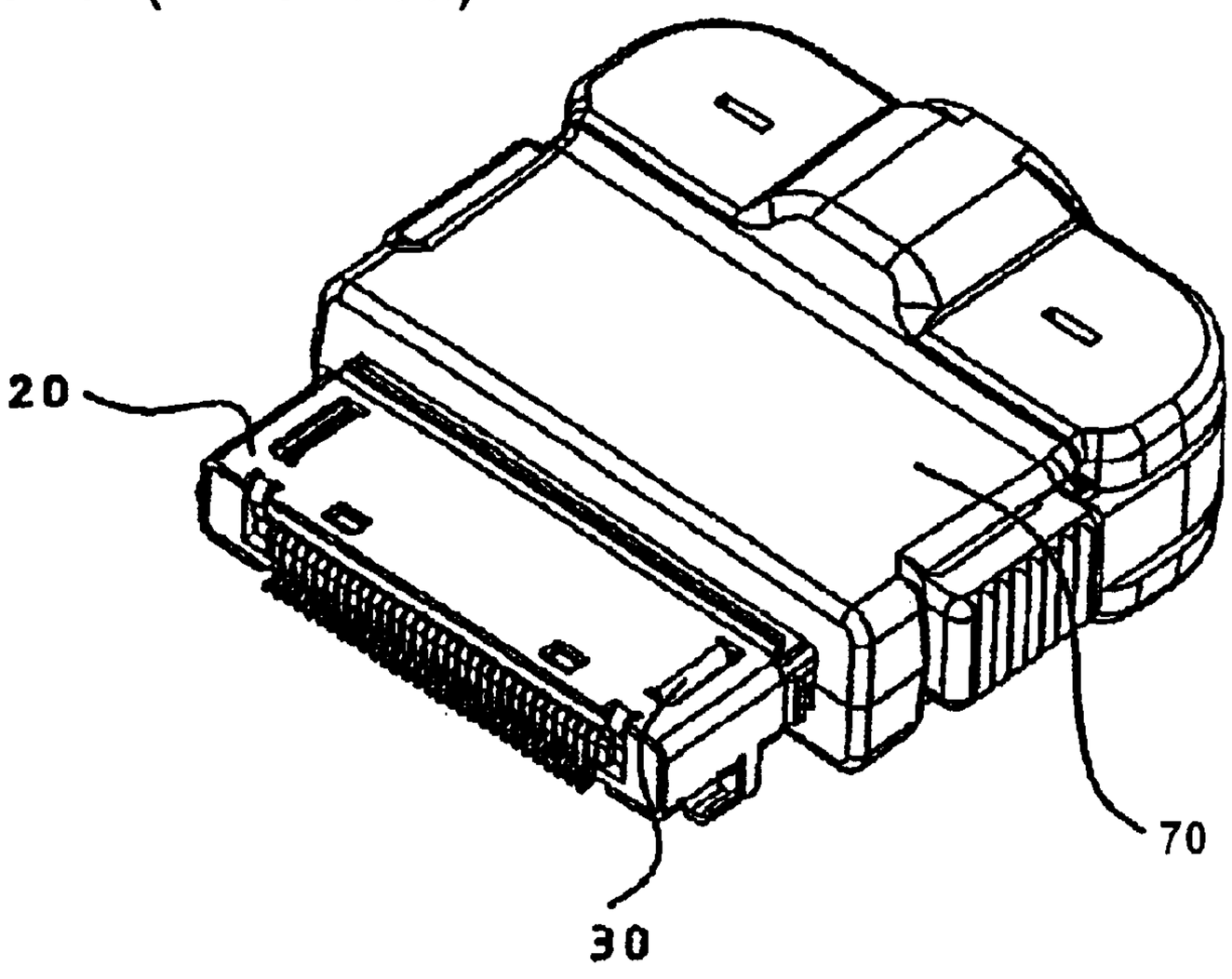


FIG. 8

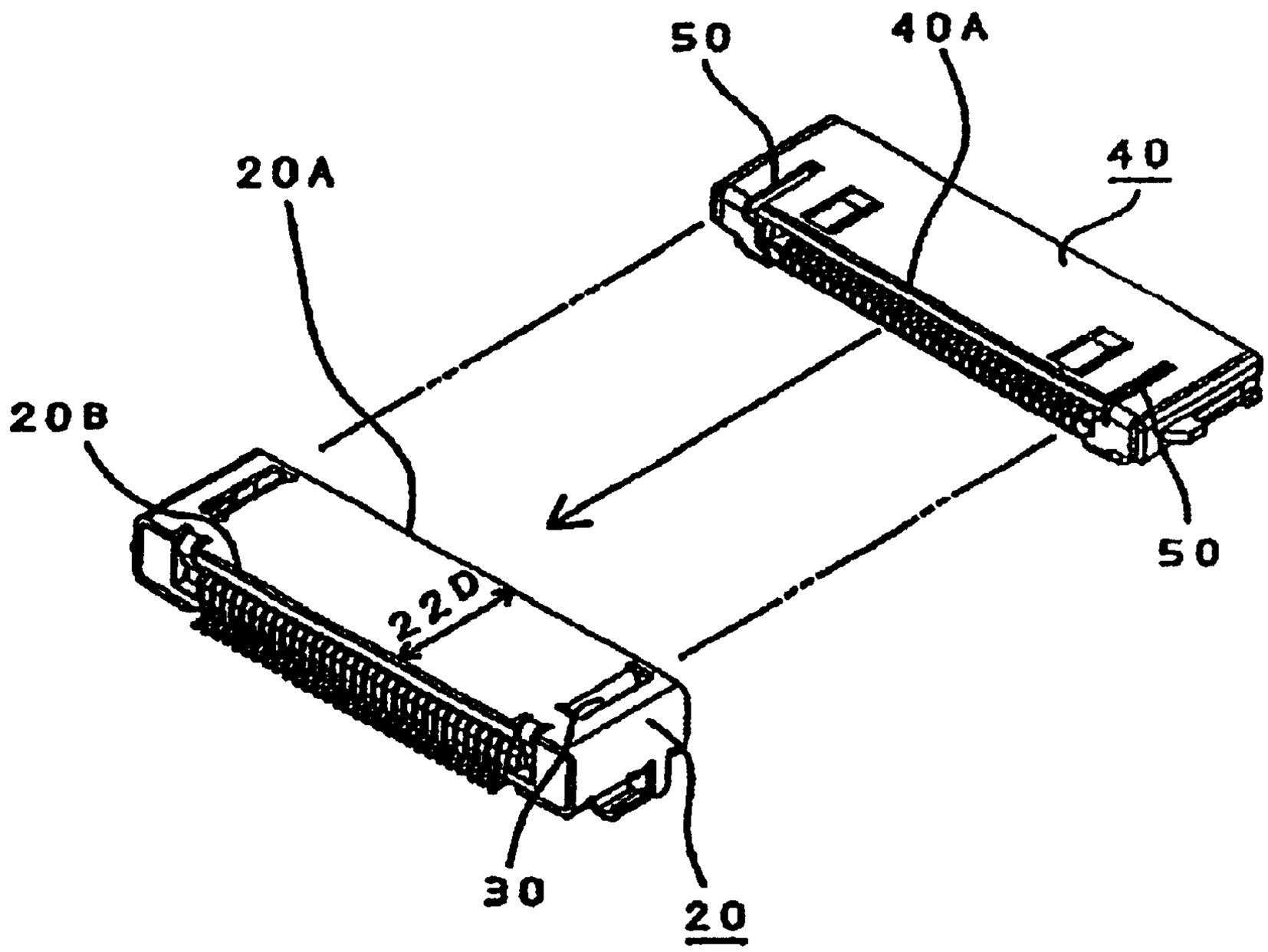
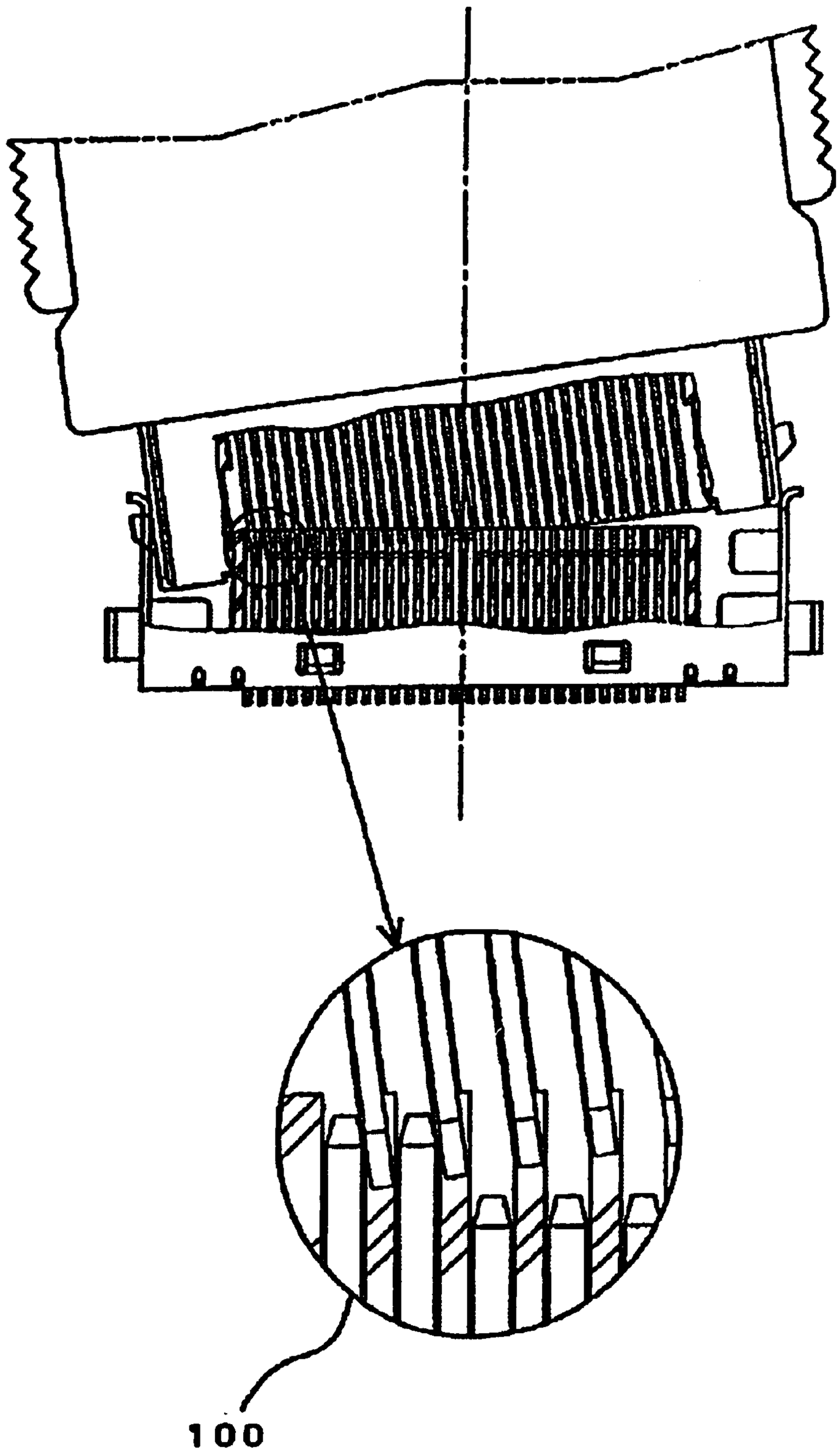


FIG. 10
PRIOR ART



CONNECTOR

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

Notice: More than one reissue application has been filed for the reissue of U.S. Pat. No. 6.776,660. The reissue applications are application Ser. Nos. 11/334,820 (present application), 29/318,045, 12/613,474, and 12/613,482 all of which are continuation reissues of 11/334,820.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a connector and more particularly to an electrical connector used in, for instance, small size electrical appliances.

2. Prior Art

In for instance, computer related electronic appliances, the electrical connections including connections to an AC adapter, to interfaces, etc. are made in many different ways. Such electrical connections are typically made by connectors that substantially comprise a receptacle (female) side connector element and a plug (male) side connector element that is brought into the receptacle side connector and coupled thereto for making electrical connection in between so that pin-shaped electrodes installed in the connector elements are connected.

More specifically, connectors typically include in their metal shells a plurality of pins (or terminals) that are arranged in parallel in their longitudinal directions and positionally secured by insulator material such as polyamide, LCP (liquid crystallization polymer), etc. The pins in the receptacle and plug side connector elements are spacedly arranged side by side in the direction in which the connector elements are made together.

Upon making connection of the plug side connector element into the receptacle side connector element, it is necessary that responsive pins in two connector elements be aligned to be on a straight line. In other words, it is necessary to avoid the connector elements from being oblique to each other when they are brought together at their front edges for connection. If the plug side connector element in an oblique posture with reference to the receptacle side connector element, as shown in FIG. **10**, is pushed into the receptacle side connector element, an irregular pin connection is made (as at **100**) as seen from the enlarged view shown in the circle in FIG. **10**, and this would cause several problems including short-circuiting.

In addition, when the plug side connector element is connected to the receptacle connector element in a slanted posture (which can easily occur when there is size differences between the receptacle and plug side connector elements), removing of the plug side connector element from the receptacle side connector element is not easily done and occasionally requires forcibly and repeated twists on the shell of the plug side connector element. This would cause damage to the pins and the shells of both connector elements.

Thus, though pin alignment is essential when connection is made between the two connector elements, such a pin alignment is not obtained easily and this difficulty can occur often when the connector is small in size and used in small size electrical devices such as a personal digital assistance (PDA), digital cameras, camcorders, etc.

SUMMARY OF THE INVENTION

Accordingly, the object of the present invention is to provide an electrical connector that allows accurate and secure connections or coupling between connector elements to be made easily without causing pin or electrode misalignment.

The above object is accomplished by a unique structure of the present invention for a connector that comprise a first connector element and a second connector element that are coupled together when the second connector element is fitted in the first connector element, and in the present invention:

the first connector element is formed with an engagement projection that extends in the direction of the depth of the first connector element, the front end of the engagement projection being spacedly apart from the front edge of the first connector element; and

the second connector element is formed with an engagement slit or slot that extends in the direction of the depth of the second connector element so that the engagement slit receives therein the engagement projection of first connector element when the first and second connector elements are connected.

With the structure above, upon connecting the second connector element to the first connector element, the front end of the engagement slit of the second connector element engages with the engagement projection of the first connecting element after the front end of the engagement slit has advanced the distance between the front edge of the first connector element and the front end of the engagement projection, and then the second connector element is pushed all the way to back of the first connector element in the depth of the first connector element while being guided by the engagement slit engaging with the engagement projection. Accordingly, even when the second connector element is obliquely pushed into the first connector element at the initial stage of coupling process, such oblique posture is corrected by the engagement projection of the first connector element as the second connector element is pushed and advanced to the back of the first connector element, and a connection between the first and second connector elements with the pins (electrodes) inside both of them being adapted straight can be made assuredly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the first connector body (first connector element) of the connector according to the present invention;

FIG. **2** is a perspective view of the second connector body (second connector element) of the connector according to the present invention;

FIG. **3** is a schematic top view of the first connector body,

FIG. **4** schematically shows the cross section of the first connector body taken along the line **44** in FIG. **3**;

FIG. **5** is a schematic top view of the second connector body,

FIG. **6** schematically shows the cross section of the second connector body taken along line **6**—**6** in FIG. **5**;

FIG. **7** illustrates the second connector body which is combined with a plug assembly,

FIG. **8** illustrates the manner of connecting the second connector body to the first connector body,

FIG. **9** illustrates the first connector body to which the second connector body (not seen) is connected; and

FIG. **10** illustrates the manner of oblique connection of the first and second connector elements in prior art connector.

DETAILED DESCRIPTION OF THE INVENTION

The connector of the present invention is comprised of a first connector body **20** (a receptacle side connector element) and a second connector body **40** (a plug side connector element).

As seen from FIGS. **1** and **2**, the first and second connector bodies **20** and **40** comprise respectively a relatively flat box shape shell **22** and **42** made of a metal and include therein a plurality of pins or elongated electrodes, which are collectively referred to by the reference numerals **24** and **44** respectively, and an insulating material (not shown) is filled therein so as to positionally secure the pins **24** and **44**.

The shell **22** of the first connector body **20** comprises, as best seen from FIG. **4**, a top shell plate **22**A and a bottom shell plate **22**B as well as side shell plates **22**C, thus forming a box shape that has a predetermined depth **22**D (see FIG. **3**) that extends from the front edge **20**A to the rear edge **20**B of the first connector body **20**. The pins **24** of the first connector body **20** are arranged parallel to the direction of the depth **22**D.

The shell **22** of the first connector **20** is formed in its top shell plate **22**A with engagement projections **30**. Each of the projections **30** is formed by cutting the top shell plate **22**A in an angled C shape, and the resulting tongue pieces **22**E are bent inward toward the interior of the shell **22**. The tongue pieces **22**E are in the shape of elongated parts of the shell **22** that extend in the direction of the depth **22**D of the first connector body **20**, and they are parallel to the side shell plates **22**C of the first connector body **20** or to the side edges **22**A' of the top shell plate **22**A.

The tongue pieces **22**E are bent at locations of distance **22**W from the side shell plates **22**C or from the side edges **22**A' of the first connector body **20** to make the engagement projections **30**. The engagement projections **30** are provided with a space of a distance L apart from the front edge **20**A of the first connector body **20**. In other words, the front ends **32** of the engagement projections **32** are spaced apart from the front edge **20**A of the first connector body **20**. The engagement projections **30** have a length **30**L which is, in the shown embodiment, about two third the depth **22**D of the first connector body **20**.

On the other hand, the shell **42** of the second connector body **40** comprises, as best seen from FIG. **6**, a top shell plate **42**A and a bottom **[**shall**]** *shell* plate **42**B as well as side shell plates **42**C, thus forming a box shape with a predetermined depth **42**D (see FIG. **6**) that extends from the front edge **40**A to the rear edge **40**B of the second connector body **40**. The overall size of the shell **42** of the second connector **42** is slightly smaller than the shell **22** of the first connector body **20** so that the second connector body **40** is fitted in the first connector body **20** from the first side of the first connector body **20**. The pins **44** of the second connector body **40** are arranged so be parallel to the direction of the depth **42**D.

The shell **42** of the second connector body **40** is formed in its top shell plate **42**A with engagement slits **50**. Each of the engagement slits **50** is formed by cutting away parts of the top shell plate **42**A linearly so that the engagement slits **50** are parallel to and adjacent to the side plates **42**C or to side edges **42**A' of the top shell plate **42**A. An alternate construction would be to mold the slits **50** into the shell **42** when the shell **42** is made. The engagement slits **50** are provided so as to extend in the direction of depth **42**D of the shell **42** of the second connector body **40**. In other words, the front end ends **52** of the engagement slits **50** are on the front edge **40**A of the second connector body **40**. The engagement slits **50** have a length **50**L which is, in the shown embodiment, about two

thirds of the depth **42**D of the second connector body **40** and is slightly larger in length than the engagement projections **30** of the first connector body **20**.

The engagement slits **50** are opened at locations of distance **42**W from the side shell plates **42**C or from the side edges **42**A' of the top shell plate **42**A of the second connector body **40**, the distance **42**W being substantially the same as the distance **22**W of the engagement projections **30** of the first connector body **20**. Thus, the engagement slits **50** positionally correspond to the engagement projections **30** of the first connector body **20**. The width W of the engagement slits **50** is substantially the same as (or slightly larger than) the thickness of the tongue pieces **22**E (engagement projections **30**) which is the thickness of the metal material of the shell **22** of the first connector body **20**.

The reference numerals **60** shown in FIG. **2** are raised springy holders formed by notching the top shell plate **42**A of the second connector body **40** and raised outwardly.

The first and second connector bodies **20** and **40** structured as described above are connected by way of mating together at the front ends of the shells **22** and **42**.

More specifically, as shown in FIG. **7**, the second connector body **40**, which is attached at its rear edge **40**B to, typically, a plug assembly **60** that is connected to, for instance, an electrical cable (not shown), is held by hand, and then is brought to the vicinity of the first connector body **20** which is installed in a casing body of, for instance, a PDA (not shown).

The front edge **40**A of the second connector body **40**, which is a plug side connector element, is set so as to face the front edge **20**A of the first connector body **20**, which is a receptacle side connector element, so that the first and second connector bodies **20** and **40** are aligned in the direction of the depth thereof (which brings an alignment of the pins **24** and **44** installed in such connector bodies **20** and **40**). In this positioning, since the distances **22**W and **42**W of the first and second connector bodies **20** and **40** are substantially equal, the engagement projections **30** of the first connector body **20** and the engagement slits **50** of the second connector body **40** are also aligned on imaginary straight lines.

Then, the second connector body **40** is pushed into the first connector body **20** as shown by arrow in FIG. **8**. During the initial pushing movement, the outer surfaces of the shell **42** of the second connector body **40** are guided by the inner surfaces of the shells **22** of the first connector **20**. After advancing the distance L which is the distance from the front edge **20**A to the front ends **32** of the engagement projections **30** in the first connector body **20**, the engagement slits **50** of the second connector body **40** come into engagement with the engagement projections **30** of the first connector body **20**. As a result, the sliding movement of the second connector body **40** in the depth **22**D of and toward the rear edge **20**B of the first connector body **20** is guided by the engagement projections **30**. The second connector body **40** is thus pushed into the first connector body **20** straight with the pins inside both connector bodies aligned straight as well and connected to the first connector body **20** (see FIG. **9**, in which the second connector body **40** is unseen since it is inside the first connector body **20**). The second connector body **40** is held inside the first connector body **20** by the raised springy holders **60** that press against the inside surface of the top shell plate **22**A of the first connector body **20**.

The width W of each engagement slit **50** is substantially the same as (or slightly larger than) the thickness of the engagement projection **30**, and thus the engagement projections **30** have substantially no space for play in the direction

perpendicular to the direction of the length of the engagement slits **50** or to the direction of the connecting direction of the first and second connector bodies **20** and **40**. Accordingly, the engagement slits **50** of the second connector body **40** make no lateral movements during the sliding movement, keeping the straight alignment obtained by the engaged engagement projections **30** and engagement slits **50**.

As a result, even when the second connector body **40** is slanted with reference to the first connector body **20** during the initial connecting stage, such a slanted positional relationship is automatically corrected to a straight relationship as the second connector body **40** is pushed into deep in the first connector body **20**, and a snug and secure engagement of the first and second connector bodies **20** and **40** is accomplished, and pins **24** and **44** of the first and second connector bodies **20** and **40** are connected properly. The engagement projections **30** and the engagement slits **50** are formed near the side edges **22**A' and **42**A' of the first and second connector bodies **20** and **40**, respectively; accordingly, the connection of the connector bodies **20** and **40** can be made in a stable fashion, and a separation of the connected connecting bodies can be made easily.

What is claimed is:

1. A connector comprising a first connector element and a second connector element that are coupled together, wherein

said first and second connector elements are each formed with a metallic shell;

said first connector element is formed with an engagement projection that projects toward an interior of said first connector element and extends in a direction of depth of said first connector element, a front end of said engagement projection being spaced apart from a front edge of said connector element by a predetermined distance;

said engagement projection is formed by cutting a C-shape slit in a top surface of said metallic shell of said first connector element and bending a tongue formed downwardly, *an engagement edge of the tongue extending by a first length in the direction of depth of said first connector element*; and

said second connector element is formed with an *elongated* engagement slit in said metallic shell *the elongated engagement slit having a second length* that *starts at a front edge of the metallic shell of the second connector element and* extends in a direction of depth of said metallic shell of said second connector for engaging with said engagement projection formed in said metallic shell of said first connector element,

wherein, the engagement projection and the elongated engagement slit are configured such that when pushing the second connector element into the first connector element, the engagement edge of the tongue of the engagement projection engages the elongated engagement slit at the front edge of the metallic shell of the second connector element to provide for straight alignment, and wherein, the first length of the engagement edge of the tongue slides along the second length of the elongated slit to guide the sliding movement as the second connector element is pushed in the direction of depth and toward a rear of the first connector element.

2. The connector according to claim **1**, wherein said engagement projection is provided at two locations of said first connector element so as to be parallel to side edges of said first connector element, and said *elongated* engagement slit is provided at two location*s* of said second connector element so as to be parallel to side edges of said second connector element and to correspond to said two locations of said engagement projections of said first connector element.

3. The connector according to claim **1**, wherein said engagement projection has a predetermined length in said depth direction and said *elongated* engagement slit has a predetermined length in said depth direction which is at said predetermined length of said engagement projection.

4. An electrical connector system comprising:

a first electrical connector including:

a body having a metallic top plate, a metallic bottom plate, a first side and a second side, the body having a width W1 and a depth D1, wherein the first and second sides are smaller relative to the top and bottom plates providing a substantially flat body;

an array of electrodes extending in the direction of the depth D1 inside the body; and

first and second projections, each projection being formed by cutting a C-shaped slit in the metallic top plate and bending a tongue formed downwardly, each projection longitudinally extending along the depth D1, the first and second projections being formed at about the same distance from the first side and the second side, respectively; and

a second electrical connector including:

a body having a metallic top plate, a metallic bottom plate, a first side and a second side, the body having a width W2 and a depth D2, wherein the first and second sides are smaller relative to the top and bottom plates providing a substantially flat body;

an array of electrodes extending in the direction of the depth D2, the array of electrodes being positionally secured by insulating material to an interior surface of the body; and

first and second elongated slits formed on the metallic top plate of the body, the first and second elongated slits starting from a front edge of the metallic top plate and longitudinally extending in the direction of the depth D2, the first and second elongated slits being formed at about the same distance from the first side and the second side of the body, respectively,

wherein, the engagement projection and the elongated engagement slit are configured such that when inserting the second connector element into the first connector element, the engagement projection engages the elongated engagement slit to provide for straight alignment and to guide the sliding movement as the second connector element is pushed in the direction of depth and toward a rear of the first connector element.

5. The electrical connector system of claim 4 wherein the array of electrodes of the second electrical connector are positionally secured to the metallic bottom plate of the body, leaving an insertion cavity in the interior of the body of the second electrical connector between the array of electrodes and the metallic top plate.

6. The electrical connector system of claim 4 wherein the second electrical connector further comprises at least one raised springy holder that is raised upwardly from the top plate of the body of the second electrical connector, the raised springy holder providing for compressive action against the body of the first electrical connector when the first and second connectors mate.

7. The electrical connector system of claim 4 wherein each of the first and second elongated slits in the second

electrical connector has a length that is about two thirds of the depth D2 of the body of the second electrical connector.

8. The electrical connector system of claim 4 wherein each of the first and second projections in the first electrical connector has a length that is about two thirds of the depth D1 of the body of the first electrical connector.

9. The electrical connector system of claim 4 wherein the first elongated slit in the second electrical connector is formed adjacent to and at a predetermined distance form the first side of the second electrical connector, and the second elongated slit is formed adjacent to and at a predetermined distance from the second side of the second electrical connector, and wherein the outermost electrodes in the array of electrodes in the second electrical connector are formed between the first elongated slit and the second elongated slit.

10. The electrical connector system of claim 4 wherein the first projection in the first connector is formed adjacent to and at a predetermined distance form the first side of the first connector, and the second projection is formed adjacent to and at a predetermined distance from the second side of the first connector, and wherein the outermost electrodes in the array of electrodes in the first electrical connector are formed between the first projection and the second projection.

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