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- (71) Applicant (for all designated States except US): FCI [FR/FR]; 18 Pare Ariane III, 3/5, rue Alfred Kastler, F-78284 GUYANCOURT CEDEX (FR).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): DE BRUIJN, Jeroen, Jozef, Maria [NL/NL]; Gildeweg 81, NL-5616 AG Loon op Zand (NL).
- (74) Agent: DE VRIES & METMAN; Overschiestraat 180, 1062 XK Amsterdam (NL).
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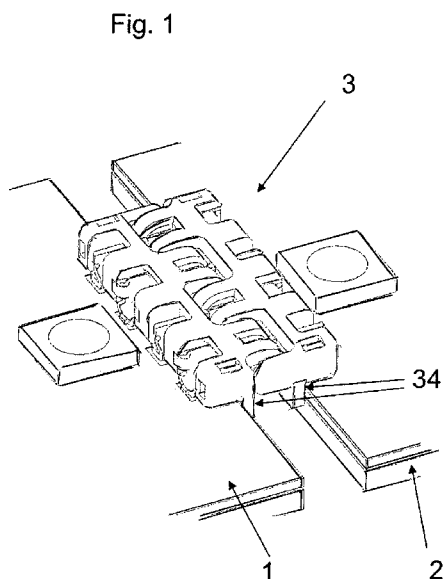
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(54) Title: HINGEABLE CONNECTOR ASSEMBLY



(57) Abstract: An electrical connector assembly (3), comprising a first connector (4, 32) and a second connector (4, 31, 32) which are pivotable with respect to each other about a main pivoting axis (19) in an assembled condition. The first connector is provided with at least one header contact (12) and the second connector has at least one receptacle contact (15) with two opposite contact faces (27, 28) receiving the header contact (12). The receptacle contact faces (27, 28) and the header contact (12) are provided with matching spherical concave and convex surface sections (18, 27, 28) in line with the pivoting axis (19).

HINGEABLE CONNECTOR ASSEMBLY

FIELD OF THE DISCLOSURE

The present invention relates to an electrical connector assembly, comprising two connectors which are pivotable with respect to each other in an assembled condition. The invention also pertains to the individual connectors of such an assembly, including a header connector, a receptacle connector and a hermaphroditic connector providing receptacle contacts as well as header contacts.

BACKGROUND OF THE DISCLOSURE

In many applications it is desirable to connect a circuit board with another component, such as a further circuit board or one or more cables, in such a way that the circuit board and the connected component are rotatably moveable with respect to each other while they remain to be electrically and mechanically connected during such rotation. This is for instance desirable with connection LED strips.

Accordingly there is a need for a hingeable or pivotable connector assembly, particularly for board-to-board or board-to-cable application, enabling easy, reliable and releasable contacting of the header contacts and the receptacle contacts without hindering the desired pivoting movements.

SUMMARY OF THE DISCLOSURE

In a first aspect, an electrical connector assembly is disclosed, comprising a first connector and a second connector which are pivotable with respect to each other about a pivoting axis in an assembled condition, the first connector being provided with at least one header contact and the second connector having at least one receptacle contact with two opposite contact faces or blades receiving the header contact, wherein the receptacle contact faces and the header contact are provided with matching spherical concave and convex surface sections in line with the pivoting axis. The spherical recesses can for instance be coined holes in the contact blades. When the

two connectors are assembled the convex surface sections will guide themselves into the corresponding recesses. The retention forces mutually exerted by the contact blades are enhanced, while, on the other hand, pivoting is not hindered.

5 In a specific embodiment, the header contacts are each provided with a spherical recess and wherein the receptacle contacts are provided with a spherical surface.

10 If the spherical radius of the spherical counter surface is larger than the spherical radius of the recesses, a substantially ring shaped contact zone is obtained. This results in a larger contact area. Particularly in such a case accurate positioning results in a better contact. To this end, the first and second connectors can be joint by a latch of one connector cooperating with a counter surface on the mating connector, the
15 latch and the counter surface being provided with matching spherical recesses and bulges in line with the pivoting axis.

In an alternative embodiment, the spherical radius of the bulges can be made smaller than the spherical radius of the recesses. This results in a point contact. Although such a point
20 contact requires less accurate positioning, it can also be combined with the aforementioned bulged latch joint.

In a further aspect, an electrical connector assembly is disclosed, comprising a first connector and a second connector which are pivotable with respect to each other about a
25 main pivoting axis in an assembled condition, the first connector being provided with at least one header contact and the second connector having at least one receptacle contact. The contacts have a surface mounting end for connection to a circuit board and a mating end contacting a matching contact. The
30 surface mounting ends of the first connector are positioned at a side opposite to the side of the second connector exposing the surface mount ends of the second connector. This way, circuit boards connected by the connector assembly are at a different level when positioned in a parallel orientation, being spaced by
35 the connector assembly. This makes it possible to pivot a circuit board between a +90 degrees position and a -90 degrees position relative to the other circuit board.

In a further aspect, an electrical connector assembly is disclosed, comprising a first connector and a second

connector which are pivotable with respect to each other about a main pivoting axis in an assembled condition, the first connector being provided with at least one header contact and the second connector having at least one receptacle contact. The contacts have a surface mounting end for connection to a circuit board and a mating end contacting a matching contact. The first and second connectors are provided with respective connector housings with a surface mount side exposing the surface mounting ends of the contacts, and a mating side exposing the mating ends of the contacts. The connector housings have a lower side provided with a ridge between the surface mount side and the mating side. The ridge increases the creep distance between the mating ends of the contacts one the one hand and the circuit board on the other.

In a specific embodiment, the first connector comprises at least one cylindrical surface with an axis parallel to the main pivoting axis, the cylindrical surface engaging a counter surface of the second connector during hinging. Optionally, the cylindrical surface and the counter surface are provided with mutually matching profiles, such as ribs extending parallel to the hinging axis, to enable stepwise relative rotation of the connectors.

The first connector of the connector assembly can be a header connector while the second connector is a receptacle connector. Alternatively, both connectors can be hermaphroditic connectors, e.g., showing identical configurations.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will hereafter be elucidated with reference to the schematic drawings showing embodiments of the disclosed connector assemblies by way of example.

Fig. 1 is a perspective view of an embodiment of an electrical connector assembly.

Fig. 2 shows in perspective view an exemplary embodiment of a connector.

Fig. 3 shows in perspective view a receptacle contact of the connector of Figure 2.

Fig. 4 shows in cross section two mating hermaphroditic connectors of the type shown in Figure 2.

Fig. 5 shows schematically in detail a mating end of a receptacle contact engaging a mating end of a header contact of an exemplary embodiment of a connector assembly.

Fig. 6 shows schematically in detail a mating end of a receptacle contact engaging a mating end of a header contact of an alternative exemplary embodiment of a connector assembly.

Fig. 7 shows in perspective view a further exemplary embodiment of a connector.

Figs. 8A-C show different positions of two pivoting connectors.

Fig. 9 shows in cross section a further exemplary embodiment of a connector.

Fig. 10A-C show a further exemplary embodiment of a connector in perspective views and side view respectively.

DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 shows two circuit boards 1, 2 connected by a pivotable connector assembly 3 comprising two mating identical hermaphroditic connectors 4. An example of such a connector is shown in more detail in Figure 2, which is different from the connector in Figure 1 in that it does not have a ridge 34 at its lower side, as will be discussed hereinafter with reference to Figure 9. The connector 4 comprises a connector housing 5, with a mating side 6 with receptacle blocks 7 having a semi-cylindrical mating end 8. The distance between the receptacle blocks corresponds to the width of the receptacle blocks 7. This way, the receptacle blocks 7 fit between the receptacle blocks 7 of a mating connector 4.

One of the ends of the connector comprises a terminal latch 9 with a contour following the semi-cylindrical contour of the receptacle blocks 7. On its side facing the closest receptacle block 7, the terminal latch 9 is provided with a spherical bulge 10. The receptacle block 7 at the opposite side comprises a recess 11 shaped to cooperate with the bulged terminal latch 9 of a mating connector 4 as a ball joint in a pivoting manner. The distance between the terminal latch 9 and

the closest receptacle block 7 is the same as the distance between the receptacle blocks 7.

The connectors 4 further comprises header contacts 12 with a mating end 13 and a surface mount end 14 (see Figure 4), and receptacle contacts 15 with a mating end 16 and a surface mount end 17 (see Figure 3). The mating ends 12 of the header contacts 12 project from the connector housing in a position centrally between two receptacle blocks 7, the last header contact being between the terminal latch and the closest receptacle block 7. Both side faces of the header contacts 12 are provided with a spherical recess 18, which are in line with the spherical bulge 10 of the terminal latch 9 and with the recess 11 in the outer surface of the terminal receptacle block 7. The imaginary line through the spherical recesses and the bulge on the terminal latch forms a pivot axis 19 (see Fig. 4).

The receptacle blocks 7 are provided with a central slit 20 providing access for a header contact 12 of a mating connector 4 for engaging a respective receptacle contact 15.

The connector side opposite to the mating side 6 is a surface mount side 21 provided with indentations 22 exposing the surface mount ends 14, 17 of the header contacts 12 and the receptacle contacts 15 to enable surface mounting of the contacts 12, 15 onto a circuit board 1, 2, as shown in Figure 1. Surface mounting can for instance take place by soldering, through hole soldering, press fit or any other suitable surface mount technique.

Figure 3 shows a perspective view of a receptacle contact as a separate part. The receptacle contact 15 is symmetrical with respect to a plane extending transversely with respect to the main pivoting axis 19 (see Fig. 4), and comprises a mating end 16 with two contact blades 25, 26 providing opposite contact surfaces 27, 28 between which a corresponding header contact blade can be received. The contact surfaces 27, 28 of the contact blades 25, 26 are convex. This way, the two opposite contact surfaces 27, 28 of the receptacle contact 15 converge towards each other along the full periphery of the semi-circular slits 20 of the respective receptacle block 7. When mounted in a connector 4 the distance between the two opposite convex contact surfaces 27, 28 is smallest at the

position of the pivoting axis 19. This way, the convex contact surfaces 27, 28 cooperate with the spherical recesses 18 in the header contacts 12 in a pivoting manner like a ball joint, as shown in Figure 4.

At the opposite end the receptacle contact 15 comprises a surface mount end 17 for mounting the receptacle connector to a circuit board 1, 2, for instance by soldering.

Within dimensional tolerances the spherical radius of the convex contact surfaces 27, 28 of the receptacle contact 15 can be equal to the spherical radius of the spherical recess 18 of the header contacts 12. However, it can be advantageous to make the radius of the contact surfaces 27, 28 smaller (see Figure 5) or larger (see Figure 6) than the radius of the recesses 18. In the first case, a point contact 29 is obtained near or at the location of the pivoting axis 19. In such a case, accurate positioning is less critical. If the spherical radius of the convex contact surfaces 27, 28 is larger than the radius of the recess 18 in the header contact 12, a ring contact 30 is obtained. This has the advantage that a larger contact area can be realized. Such a large contact area can particularly be obtained by improving accurate positioning, for instance by use of the ball joint mechanism provided by the terminal latch 9 and the matching recess 11 in the outer surface of the cooperating receptacle block 7.

Figure 7 shows an alternative embodiment of a connector 31, which is substantially identical to the connector shown in Figure 2, with the difference that the header contacts 12 and receptacle contacts 15 are positioned upside down within the connector housing 5. Using a connector assembly combining such a connector 31 with a connector 4 of Figure 2 makes it possible to connect a first circuit board at the lower side of the connector assembly 3 with a second circuit board 2 at the top side of the connector assembly. This is shown in Figure 8B. This way, the second circuit board 2 can be moved between a +90 degrees position and a -90 degrees position relative to the first circuit board 1, as shown in Figures 8A and 8C respectively.

Figure 9 shows in cross section a further embodiment of a connector 32, similar to the connector 4 of Figure 2. The connector 32 is mounted on the edge of a circuit board 1. The

housing 33 of this connector 32 comprises a ridge 34 between the surface mount ends 14, 17 of the contacts 12, 15 and the semi-cylindrical mating side 8 of the housing 33. The ridge 34 enhances the creep distance between the electroconductive parts 35 of the circuit board and the electroconductive parts 12, 15 of the mating end of the connector 32.

Figures 10A-C shows a further exemplary embodiment of a connector assembly 40 with a first connector 41 and a second connector 42 which are pivotable with respect to each other about a main pivoting axis 43 (see Figure 10C) in an assembled condition. Figures 10A and 10B show the assembly 40 in perspective views from two opposite sides. Figure 10C shows a cross section along line C-C in Figure 10B. In this embodiment, the first and second connector 41, 42 are identical and interchangeable. As with the embodiment of Figure 1, the first and second connectors 41, 42 are provided with header contacts 44 and receptacle contacts 45 receiving the header contacts 44. The connectors 41, 42 comprises a connector housing 46 with receptacle blocks 47 having a semi-cylindrical mating end 48. The distance between the receptacle blocks 47 corresponds to the width of the receptacle blocks 47. This way, the receptacle blocks 47 of the first connector 41 fit between the receptacle blocks 47 of the second connector 42 and vice versa.

In the embodiment of Figures 10A-C the semi-cylindrical ends 48 are provided with ribs 49 extending in a direction parallel to the main pivoting axis 43. In the assembled condition the ribbed semi-cylindrical ends 48 face a recessed surface 50 of the mating connector. The recessed surface 50 is provided with a single rib 51 (see Figure 10C) dimensioned to cooperate with the ribs 49 of the ribbed semi-cylindrical end 48. This way, the two connectors 41, 42 can be rotated relative to each other in a stepwise manner and the connectors 41, 42 are biased to a limited number of relative positions.

The invention is not limited to the embodiment shown in the drawings and described hereinbefore, which may be varied in different manners within the scope of the claims.

CLAIMS

1. An electrical connector assembly (3), comprising a first connector (4, 32) and a second connector (4, 31, 32) which are pivotable with respect to each other about a main pivoting axis (19) in an assembled condition, the first connector being
5 provided with at least one header contact (12) and the second connector having at least one receptacle contact (15) with two opposite contact faces (27, 28) receiving the header contact (12), wherein the receptacle contact faces (27, 28) and the header contact (12) are provided with matching spherical concave
10 and convex surface sections (18, 27, 28) in line with the pivoting axis (19).

2. An assembly according to claim 1, wherein the header contacts (12) are provided with a spherical recess (18) and wherein the contact faces (27, 28) of the receptacle
15 contacts (15) comprise matching convex surface sections (27, 28).

3. An assembly according to claim 1 or 2 wherein the spherical radius of the contact surfaces (27, 28) is larger than the spherical radius of the recesses (18).

4. An assembly according to claim 1 or 2 wherein the spherical radius of the contact surfaces (27, 28) is smaller than the spherical radius of the recesses (18).

5. An assembly according to any one of the preceding claims wherein the first and second connectors are joint by at
25 least one latch (9) of one connector cooperating with a counter surface (11) on the mating connector, the latch and the counter surface being provided with matching spherical recesses (11) and bulges (10) in line with the pivoting axis (19).

6. An assembly according to any one of the preceding
30 claims wherein the first connector (31) comprises receptacle and header contacts (12, 15) having surface mount ends (14, 17) positioned at an upper side (23) of the connector and wherein the second connector (4) comprises receptacle and header contacts (12, 15) having surface mount ends (14, 17) positioned
35 at a lower side (22) of the connector.

7. An assembly according to any one of the preceding claims wherein at least one of the connectors is provided with a

ridge (34) of an isolative material at the side of the surface mount ends.

8. An assembly according to any one of the preceding claims wherein the first and second connector (4, 32) are
5 identical hermaphroditic connectors.

9. An assembly (40) according to any one of the preceding claims wherein the first connector (41, 42) comprises at least one cylindrical surface (48) with an axis (43) parallel to the main pivoting axis (19), the cylindrical surface engaging
10 a counter surface of the second connector during hinging, wherein the cylindrical surface and the counter surface are provided with mutually matching profiles to enable stepwise relative rotation of the connectors (41, 42).

10. Connector for use in an assembly according to any
15 one of the preceding claims wherein the connector (4, 31, 32) is a header connector, a receptacle connector or a hermaphroditic connector.

Fig. 1

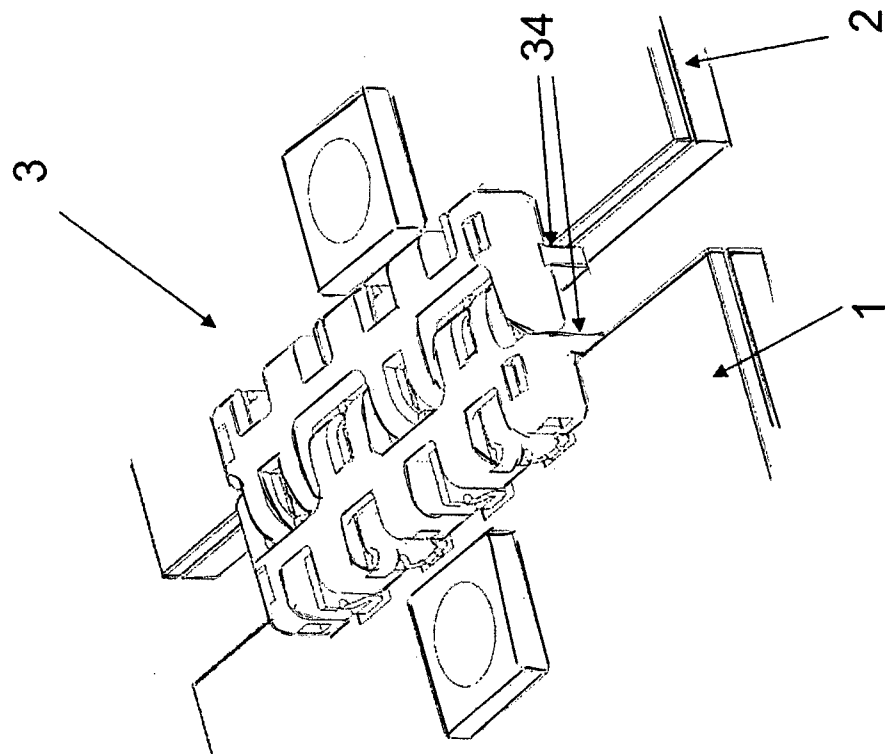


Fig. 2

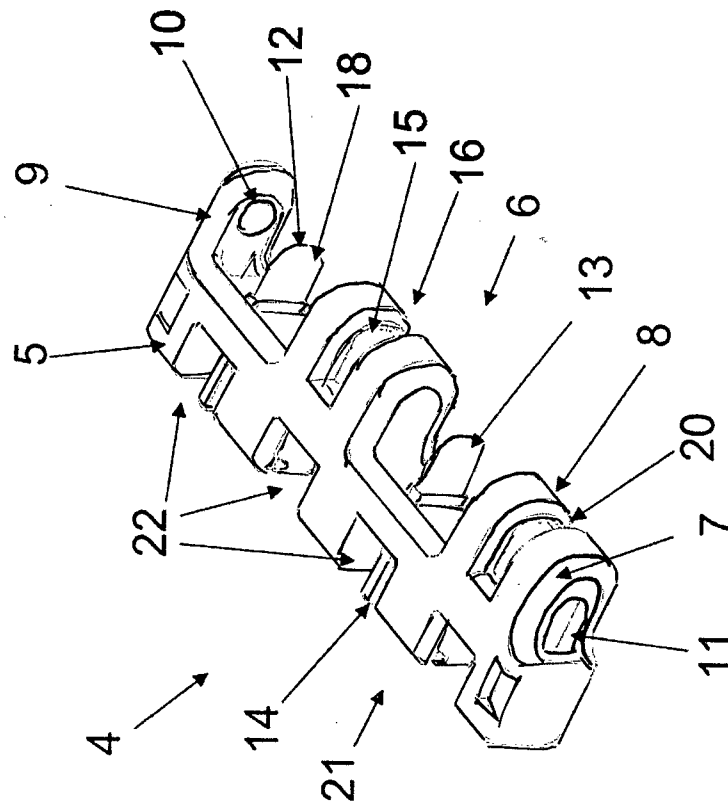
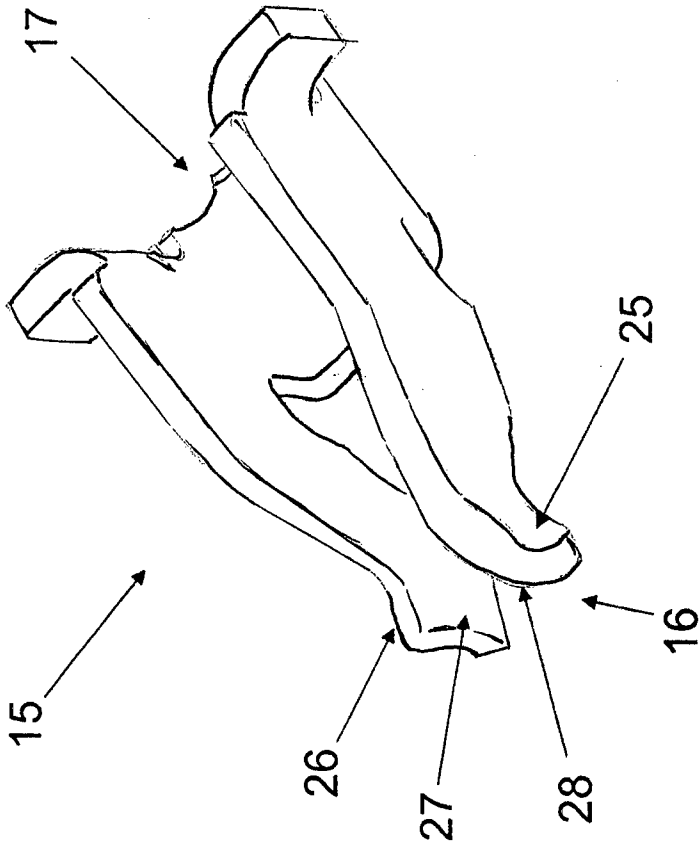


Fig. 3



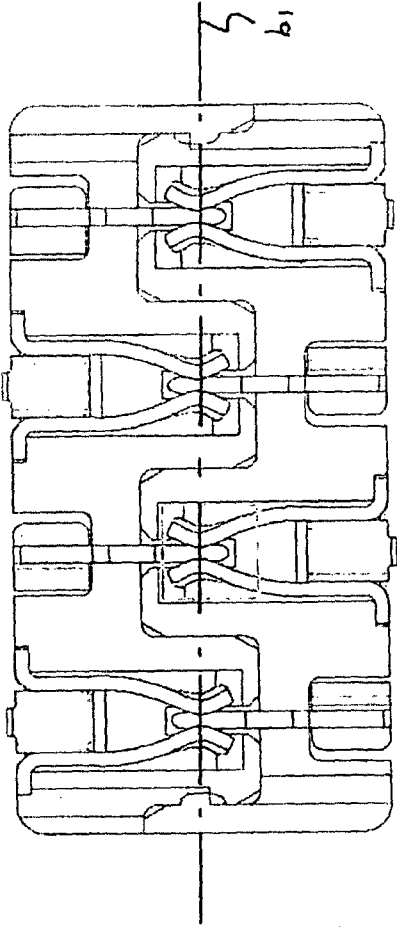


FIG. 4

FIG. 5

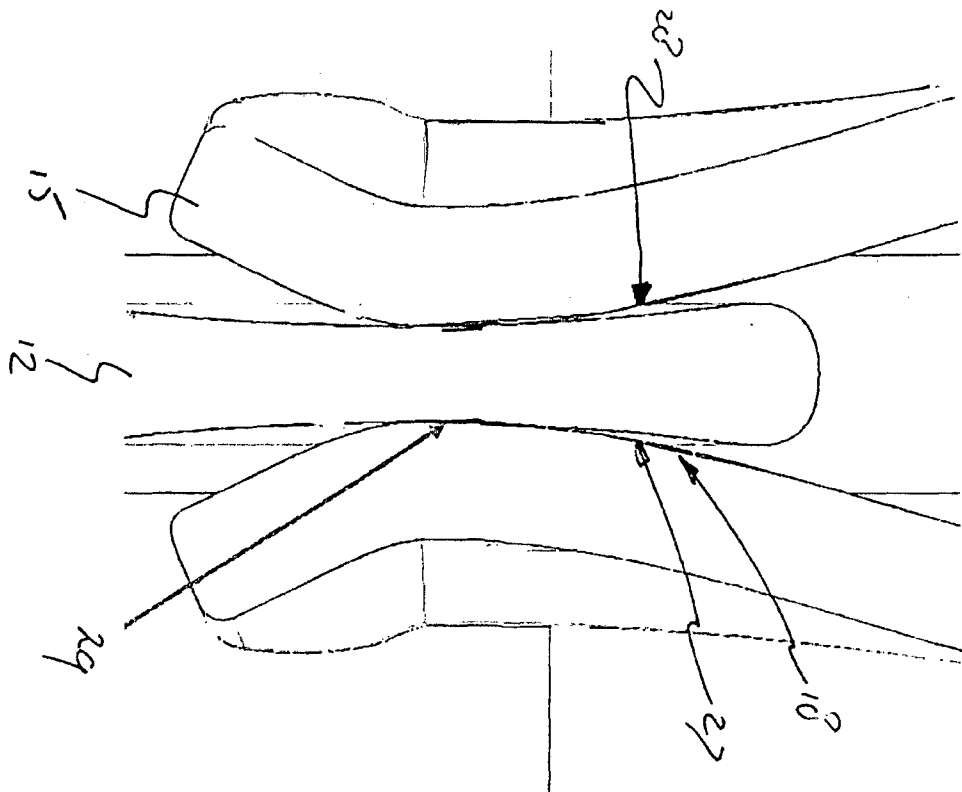
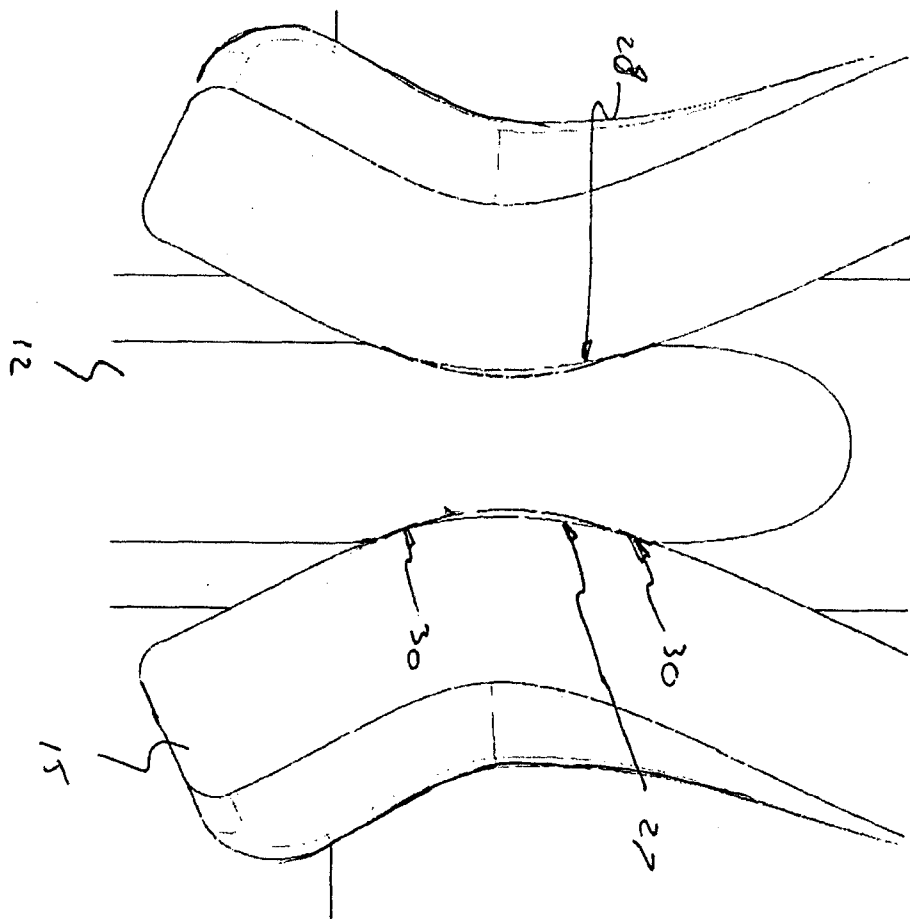


FIG. 6



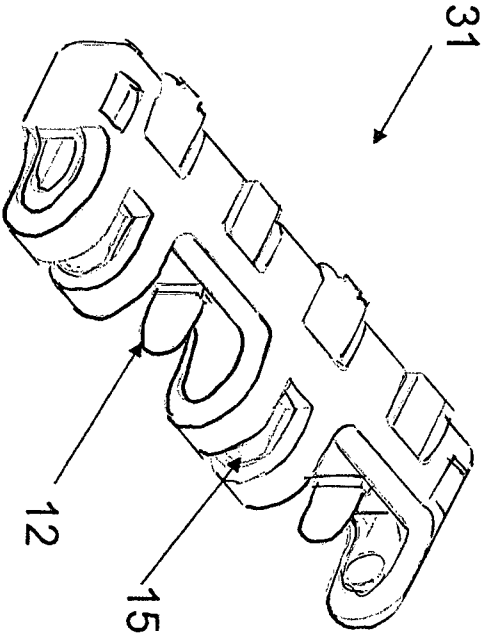


Fig. 7

Fig. 8A

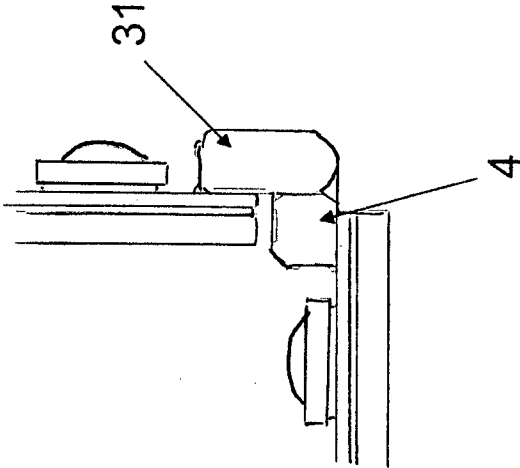


Fig. 8B

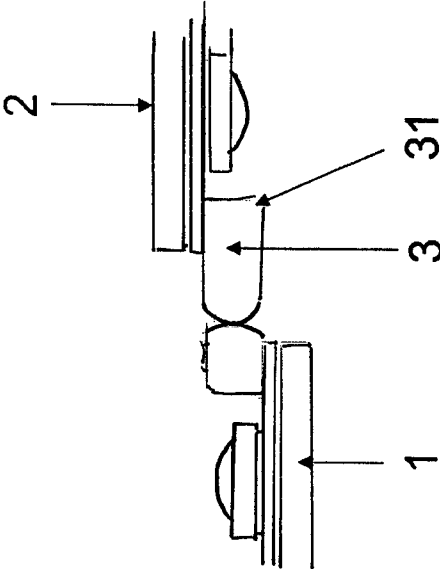


Fig. 8C

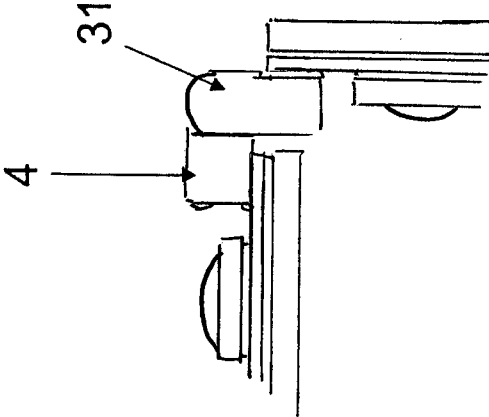


Fig. 9

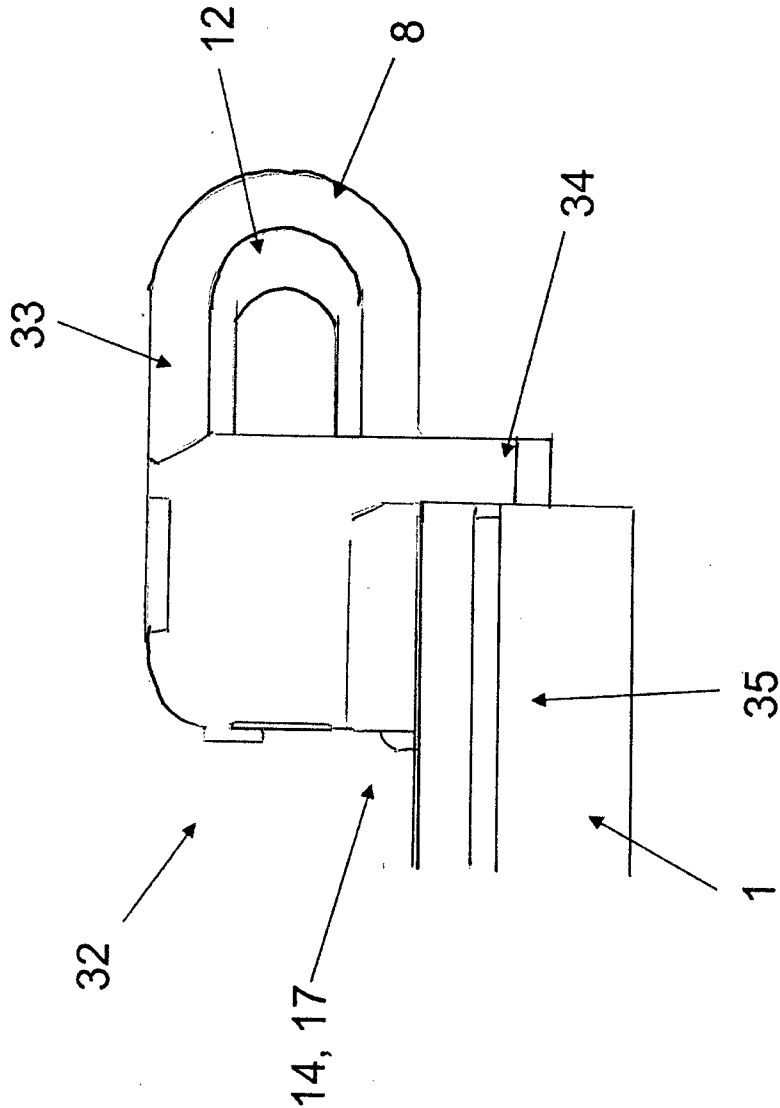


Fig. 10A

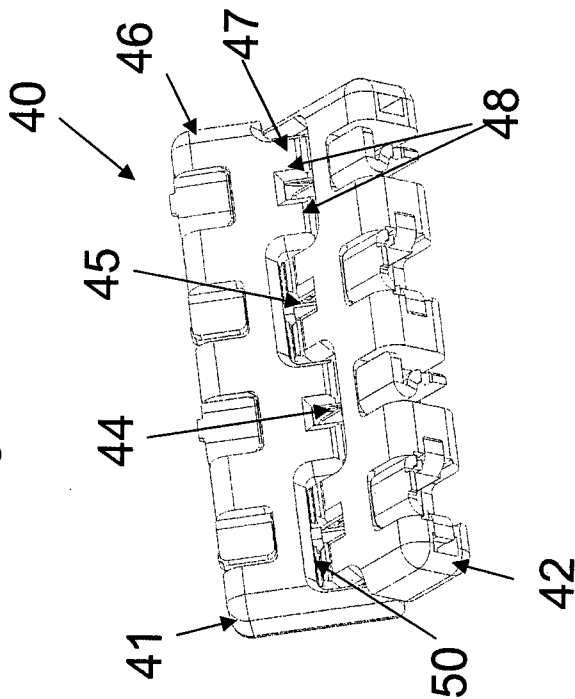


Fig. 10B

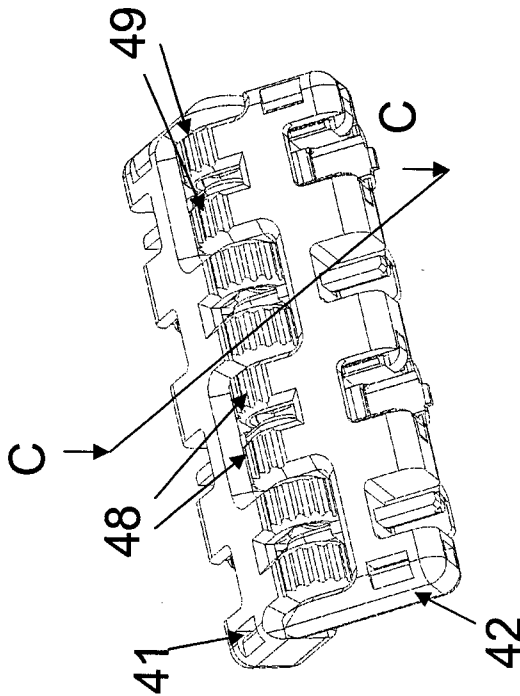
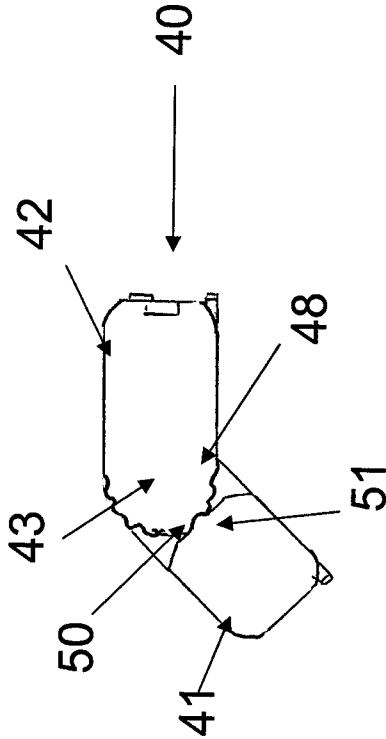


Fig. 10C



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R35/04 H01R12/73
ADD. H01R24/84

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

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 practicable, search terms used)

EP0-Internal, 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	US 2012/021614 A1 (CHEN QI [TW]) 26 January 2012 (2012-01-26) figures 1,3,4,12,15 -----	1,7,9,10
X	WO 90/09046 A1 (AMP INC [US]) 9 August 1990 (1990-08-09) figures 1-5 -----	1
X	US 5 542 850 A (FRANTZ ROBERT H [US]) 6 August 1996 (1996-08-06) figures 1-13 -----	1,5,6
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Further documents are listed in the continuation of Box C.



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8 January 2013

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

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Hugueny, Bertrand

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/001164

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