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(54) **Title:** ELECTRICAL CONNECTOR WITH TERMINAL POSITION ASSURANCE AND TERMINAL PROTECTION DEVICE

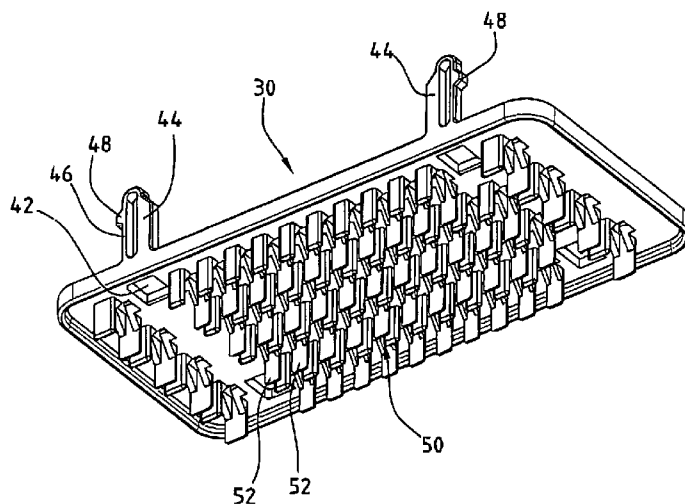


FIG. 4

(57) **Abstract:** An electrical connector (1) with male terminals (4). The electrical connector comprises a grid (30) for protecting the male terminal tips when the connector is not plugged in with a counterpart connector (36). The grid further comprises secondary locking means for blocking, when the connector and the counterpart connector are plugged in together, primary locking means provided for maintaining the male terminals in cavities of the connector housing.

Electrical connector with terminal position assurance and terminal protection device

The present invention relates to an electrical connector, such as a motorized vehicle connector, and also to a connector assembly comprising such an electrical connector.

5 Motorized vehicles comprise electrical circuits for powering motors, light bulbs, electronic devices, etc. These electrical circuits include electrical cables and connectors.

Such connectors may include a front plate or grid movable between a preassembly position, for protecting male terminals, and a closed position,
10 allowing the coupling of the male terminals with corresponding female terminals provided on a complementary or counterpart connector.

Front plate of this type are used to protect the male terminals, which are formed as thin projecting pins, when the electrical connector is not coupled with a complementary electrical. By thin projecting pins, it is meant pins having for
15 example a diameter smaller than 1,5 mm.

In the preassembly position, the front plate is located near the front end of the electric male terminals, protects them and prevents them from being deformed or damaged when they are not inserted in respective female terminals, or when the connector and its counterpart are being plugged in together.

20 When the connector is coupled with a complementary connector, the front plate is moved to a closed position against the front face of the housing of the connector so that the male terminals engage the respective female terminals of the complementary connector.

It is also known to use secondary retaining means arranged to cooperate
25 with primary retaining means for retaining the terminals inside respective cavities provided in a housing of the connector to prevent withdrawal of the terminals, in order to determine correct insertion of the electric male terminals inside the cavities of the housing and to prevent the release of the terminals by the primary retaining means.

The secondary retaining means are arranged to prevent the coupling of the electrical connector with a complementary connector if a terminal is not fully or correctly inserted in the corresponding cavity.

It is an object of the present invention to provide an electrical connector incorporating, in a straightforward, reliable, low-cost manner, both the functions of protection of the terminals and determination of correct engagement of the terminals.

To this end, the present invention relates to an electrical connector according to claim 1.

In this electrical connector, the protection and the determination of the correct engagement of the male terminals are carried out by a single element cooperating with the housing. The electrical connector is therefore particularly simple to handle and to produce.

The present invention may also other optional features of the electrical connector corresponding to claims 2 and 3, considered either independently or in combination.

The present invention also relates to a connector assembly comprising an electrical connector carrying male terminals and a complementary electrical connector carrying female terminals, wherein the electrical connector carrying male terminals is as described above.

Other aspects and advantages of the invention will appear upon reading the following description, given by way of example and made with reference to the annexed drawings, wherein:

- Figure 1 is a perspective view of an electrical connector according to the invention, a part of which is cut-away, the front plate being in the preassembly position,

- Figure 2 is an enlarged view of area II of figure 1,

- Figure 3 is a perspective view of the front face of the front panel,

- Figure 4 is a perspective view of the rear face of the front panel,

- Figure 5 is a perspective view of a connection device according to the invention, a part of which is cut-away, the electrical connector and the complementary connector being coupled,

- Figure 6 is a section view along line VI-VI of the area VI of figure 5.

In the description, the terms “front”, “rear”, “frontward”, “rearward” are defined relative to an assembly direction A represented by an arrow in figures 1 and 5. The assembly direction A is the direction in which the electrical connector is coupled with a complementary or counterpart connector, as will be described below.

The electrical connector 1 depicted in Figure 1 comprises mainly a housing 2 for receiving and maintaining male terminals 4. The housing 2 comprises a plurality of longitudinal cavities 6 having respective axes parallel to the assembly direction and for receiving respective male terminals 4. Each cavity 6 comprises a front opening 8 provided in the front face 10 of the housing 2 for the passage of the front end 12 of the respective male terminals 4. The front end 12 of a male terminal is connected to a cable 14 inserted in a cavity 6 through a rear opening of said cavity.

The male terminals 4 are maintained in the respective cavities 6 by primary retaining means cooperating with a retaining seat 16 provided on each terminal 4. As shown in Figure 6, the primary retaining means comprise, for each terminal 4, a first elastic lance 18 and a second elastic lance 20 projecting on opposite walls of a cavity 6 towards the center of said cavity and in direction A towards the front opening 8. The surface of each lance 18, 20 has a tooth 22 which clicks inside the retaining seat 16 of the terminal 4. The tooth 22 has a profile designed so as to allow the insertion of the terminal 4 past the lances 18, 20 in the assembly direction but to prevent the withdrawal of the terminal 4 in the opposite direction. To that end, each tooth 22 comprises a rear face 24 having a smooth slope and a front face 26 defining a stop preventing the withdrawal of the terminal 4.

A gap 28 is provided between each lance 18, 20 and the respective wall of the cavity 6 from which the lance 18, 20 projects. This gap 28 allows the lances 18, 20 to elastically deform towards the wall from which it projects during the insertion of the terminal 4. When a terminal 4 is fully inserted inside the cavity 6, the retaining seat 16 of the terminal 6 faces the teeth 22 of the lances. The lance shape is then restored toward a position in which it is less (or not) stressed and deformed. The terminal 4 is then retained inside the cavity 6. It is to be noted that when the terminal 4 is not fully or incorrectly inserted in the cavity 6, the lances 18, 20 remain deformed and project inside the gaps 28.

As shown on Figure 1, a front plate 30 is mounted on the front face 10 of the housing 2. The front plate 30 comprises a plurality of apertures 32 facing the front openings of the cavities 6 and allowing the passage of the front end 12 of the terminals 4. The apertures 32 are arranged to center the front end 12 of the terminals 4 and to guide them towards respective female terminals 34 of a complementary electrical connector 36 during the coupling of the connector 1 with said complementary connector 36 as shown in Figure 5. The front plate 30 is more clearly visible on Figures 3 and 4.

The front plate 30 is arranged to protect the front ends 12 of the terminal 4 when the connector 1 is not coupled with a complementary connector 36. To this aim, the front plate 30 is moveable between a preassembly position (figures 1 and 2), for protecting the terminals 4, and a closed position (figure 5 and 6), allowing mating the male terminals 4 with the corresponding female terminals 34. In the preassembly position, the apertures 32 surround the front extremity of the front ends 12 of the terminals 4 and in the closed position, the front plate 30 is placed against the front face 10 of the housing 2 and the top ends 12 of the terminals project forward from said plate 30.

To ensure that the front plate 30 is maintained in the preassembly position when the connector 1 is not coupled with a complementary connector 36, the front plate 30 and the housing 2 comprise releasable mutual fixing means. These mutual fixing means comprise for example locking rods 38 extending frontward from the front face 10 of the housing 6. The locking rods 38 each comprise a fork made of two teeth, said teeth engaging respectively the front face and the rear face of the front plate 30 around the openings 42. Consequently, the locking rods 38 interlock with the front plate 30 and maintain it in the preassembly position. The locking rods 38 are elastically deformable so that it is possible to bend them, for example by the action of the complementary connector 36, during the coupling of the connector 1 and the complementary electrical connector 36, in order to move the front plate 30 towards the closed position.

The mutual locking means are therefore operated by the complementary electrical connector 36. When, the connector 1 is coupled with the complementary connector 36, the locking rods 38 penetrate in the corresponding housing (as shown on Figure 6) provided in the complementary connector 36. A projection 54

is provided in said housing. The projection 54 acts on the top of the tooth 40 located at the free end of the locking rod 38 in order to deform the locking rods 38 and release the front plate 30 from said locking rods. By further pushing the complementary connector 36 toward the front face 10 of the connector 1, the front plate 30 moves towards its closed position.

Such mutual locking means are described in FR-2 778 502 and the man of the art can refer to this document to arrange the mutual locking means and understand their operation.

In order to enable the repositioning of the front plate 30 in its preassembly position when the connectors 1 and 36 are decoupled, the front plate 30 comprises at least an anchor device 44 for cooperating with at least an abutment projection provided on a wall of a housing (not shown) for receiving the anchor device 44 provided in the complementary connector 36. The anchor device 44 comprises an elastic arm 46 extending frontward from the front plate 30. The arm 46 comprises a tooth 48. The abutment projection of the complementary connector has a smooth slope (not shown), enabling the passage of the tooth 48 during the insertion of the elastic arm 46 in the housing for receiving the anchor device 44, and an abutment surface (not shown) hooking the tooth 48 during the withdrawal of the elastic arm 46 from said housing. When unplugging the connectors 1 and 36, the abutment projection of the complementary connector 36 pulls the tooth 48 in the direction A which causes the front plate 30 to move towards its preassembly position. Once the front plate 30 is in the preassembly position, the locking rods 38 interact with the front plate 30 with a greater force than the force needed to release the tooth 48 from the abutment projection. Therefore, the complementary connector 36 can be decoupled from the connector 1 while the front plate 30 remains in its preassembly position.

Such an anchor device is also described in FR-2 778 502 and the man of the art can refer to this document to arrange the anchor device and understand its operation.

The front plate 30 further comprises secondary retaining means 50 disposed on the rear face of the front plate 30 as shown in Figures 4 and 6. The secondary retaining means 50 comprise a number of interacting elements 52 projecting rearward from the rear face of the front plate 30. In the embodiment

shown on the figures, and in particular on Figure 6, there are two interacting elements 52 for each aperture 32 of the front plate 30. These two interacting elements are placed on opposite sides of the corresponding aperture 32. The interacting elements 52 are wedges which penetrate inside the gaps 28 provided in the housing between the lances 18 and 20 and the walls from which they project when the front plate is moved in its closed position. As shown in Figure 6, when the interacting elements 52 are engaged in the gaps 28, they prevent the lances to deform and therefore they prevent the release of the terminals 4 by the primary retaining means.

Furthermore, when a terminal 4 is not correctly or fully inserted in its cavity 6, the corresponding lances 18 and 20 project inside the gaps 28, as described above. The interacting elements 52 are therefore prevented from penetrating in the gaps 28 by the lances 18 and 20. Consequently, the front plate 30 can not be moved in its closed position against the front face 10 of the housing 2. One can therefore detect the correct or incorrect engagement of the male terminals with the secondary retaining means.

In addition, the connector 1 and the complementary connector 36 are arranged so that they can be coupled and fixed one to the other only if the front plate 30 is in its closed position. Therefore, if a terminal is incorrectly positioned in its cavity, the coupling of the connector with a complementary connector is prevented. The connector 1 is thus fault-proof.

The above described connector 1 and connection device (comprising a connector 1 and a complementary connector 36) are particularly simple to produce and to use, the protection of the terminals and the determination of correct engagement of the terminals being both carried out by a single element, i.e. the front plate 30.

The connector 1 is therefore less expensive, less fragile and easier to handle.

Changes can be made to the connector 1 without departing from the scope of the present invention. For example, the locking rods of the releasable mutual fixing means can be replaced by elastic arms projecting rearward from the front plate 30 and cooperating with corresponding cavities provided in the housing 2, as described in FR-2 778 502.

REVENDECATIONS

1.- Electrical connector (1) comprising:

- a housing (2) defining a number of cavities (6) for housing respective male terminals (4), said cavities (6) each comprising a front opening (8) for the passage
5 of a male terminal (4),

- primary retaining means (18, 20) for retaining said terminals (4) inside respective said cavities (6) and preventing withdrawal of the terminals (4),

- a front plate (30) comprising apertures (32) for the passage of the male terminals (4), and being movable between a preassembly position, for protecting
10 the terminals (4), and a closed position, designed to be hold when a complementary connector (36) is plugged in with said electrical connector (1) for mating the male terminals (4) with corresponding female terminals (34) provided on the complementary connector (36),

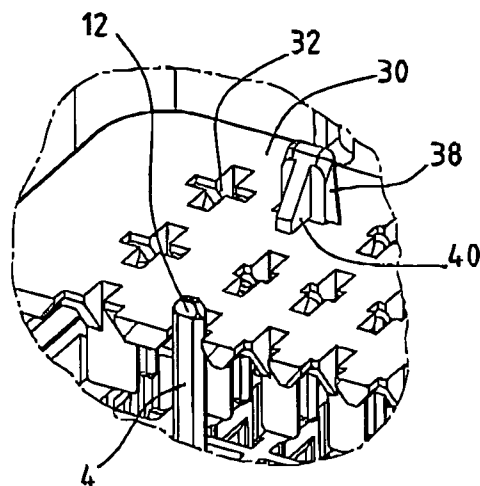
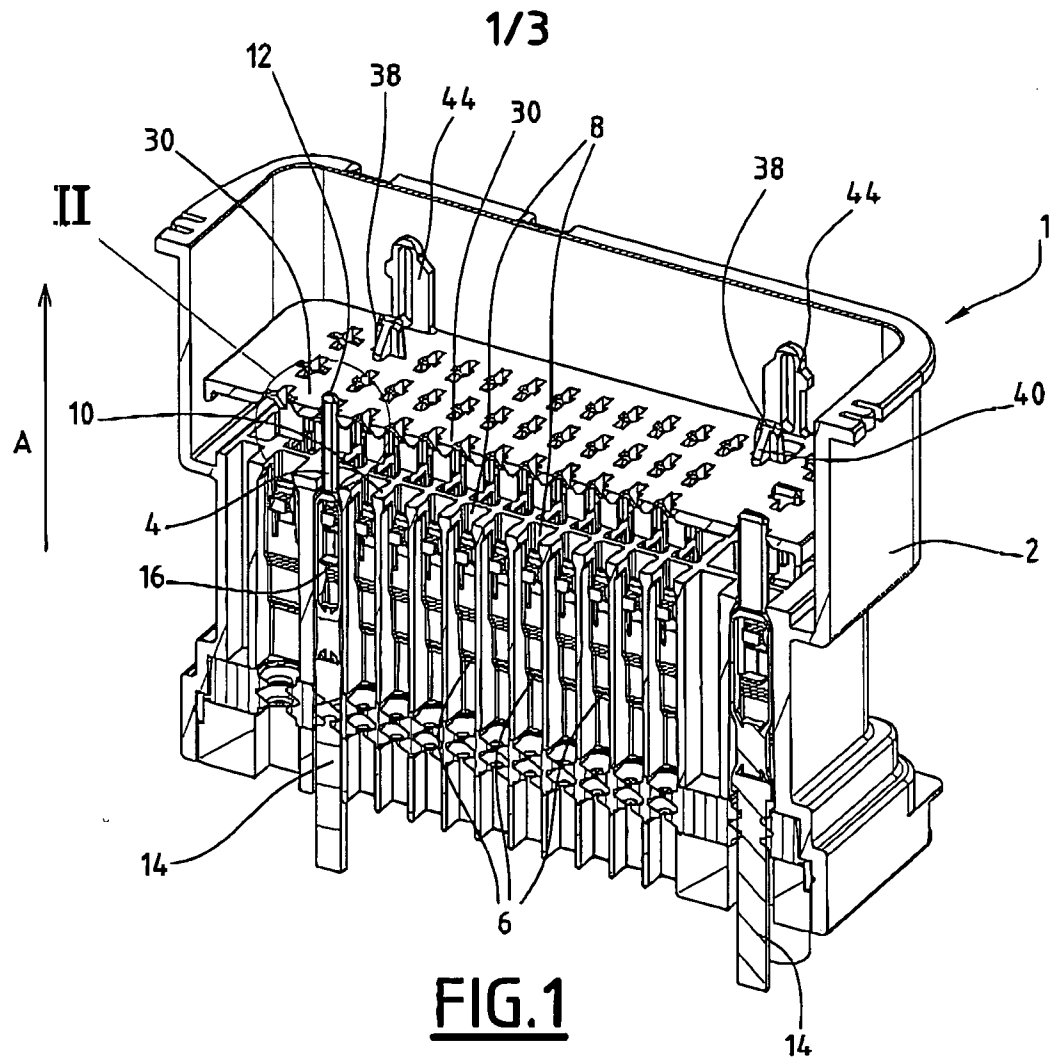
wherein the front plate (30) comprises secondary retaining means (50), the
15 secondary retaining means (50) cooperating with the primary retaining means (18, 20) when the front plate (30) is in the closed position to determine correct engagement of the male terminals (4) and prevent release of said terminals (4) by the primary retaining means (18, 20), said secondary retaining means (50) being also designed for preventing the coupling of the connector (1) with the
20 complementary connector (36) if said front plate (30) is not in the closed position.

2.- Electrical connector according to claim 1, wherein the secondary retaining means (50) comprise a number of interacting elements (52), interacting with said primary retaining means (18, 20) and projecting rearward from the front plate (30).

25 3.- Electrical connector according to claim 2, wherein the interacting elements (52) penetrate, in the closed position of the front plate (30), in respective gaps (28) provided in the housing (2) when the male electrical connectors (4) are correctly engaged in the cavities (6) and are prevented from engaging in said gaps (28) by the primary retaining means (18, 20) when a male electrical connector (4)
30 is not correctly engaged in a cavity (6).

4.- Connector assembly comprising an electrical connector (1) according to any of claims 1 to 3 and carrying male terminals (4) and an complementary electrical connector (36) carrying female terminals (34), wherein the front plate

(30) and the housing (2) comprise releasable mutual fixing means which are operated by the complementary electrical connector (36) carrying female terminals (34), said complementary electrical connector (36) comprising a projection for releasing the mutual fixing means and enabling the front plate (30) to move from its preassembly position to its closed position.



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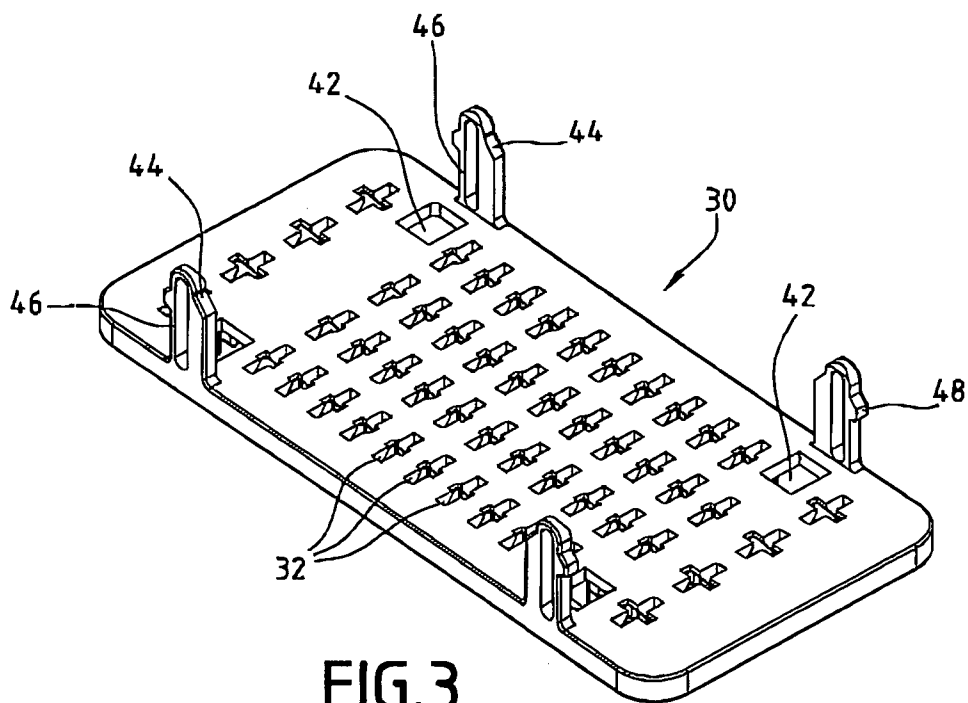


FIG. 3

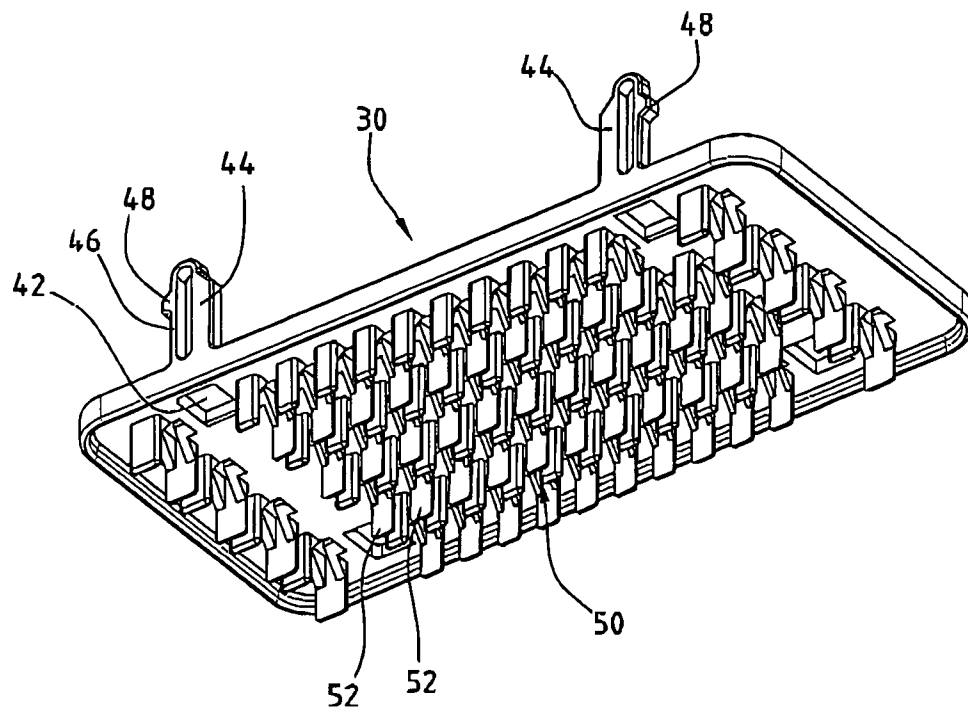


FIG. 4

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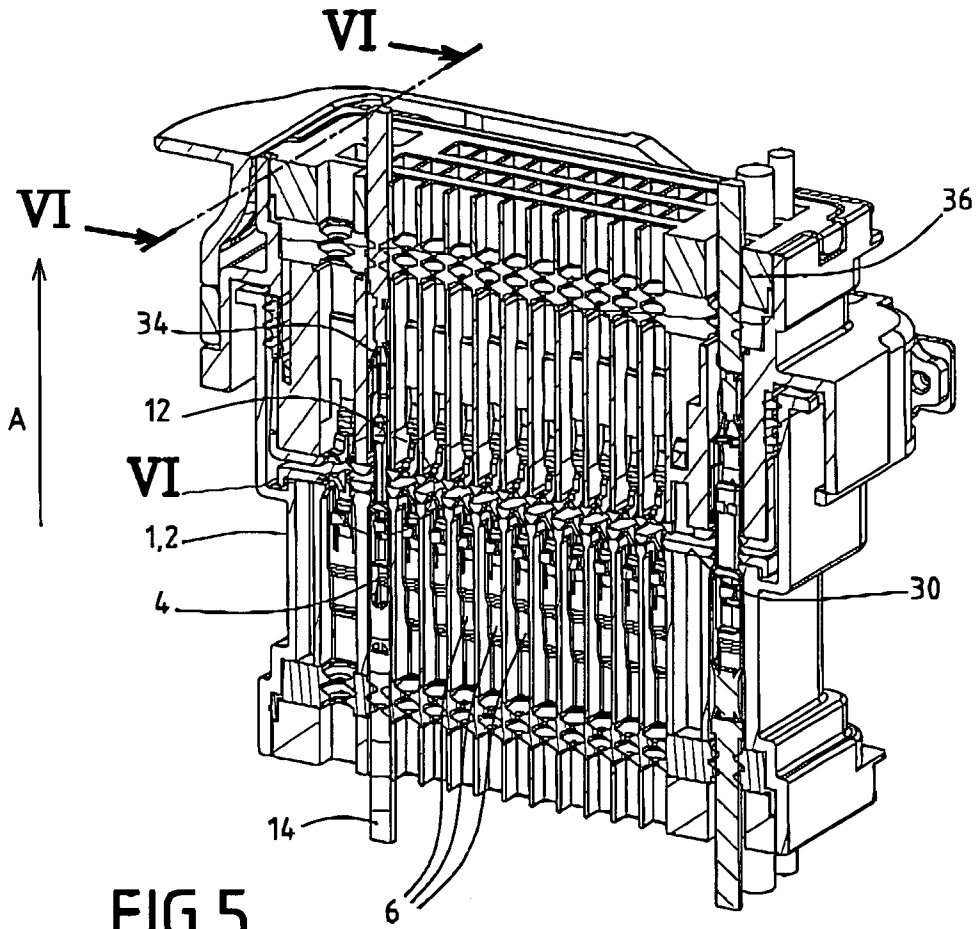


FIG.5

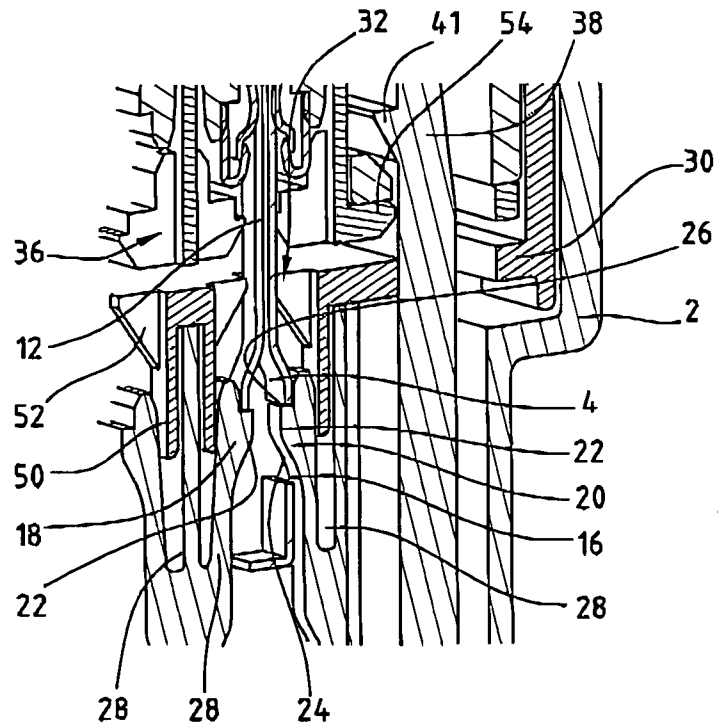


FIG.6

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2008/054469

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R13/631 H01R13/422

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 685 506 B1 (NAKAMURA HIDETO [JP] ET AL) 3 February 2004 (2004-02-03)	1-3
Y	the whole document	4
Y	US 5 558 526 A (NAGAMINE AKIRA [JP]) 24 September 1996 (1996-09-24)	4
	the whole document	

☐ 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
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- *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

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- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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- *&* document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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