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(54) Connector with TPA position dectection

(57) A connector (1) with a TPA member (20) for locking the latching elements (12) of the terminals (31).

When one of the terminals (31) is not in its fully inserted position, the TPA member is prevented from reaching its final position which is detected by TPA position detecting means (50) that prevents mating of the connector with the complementary connector.

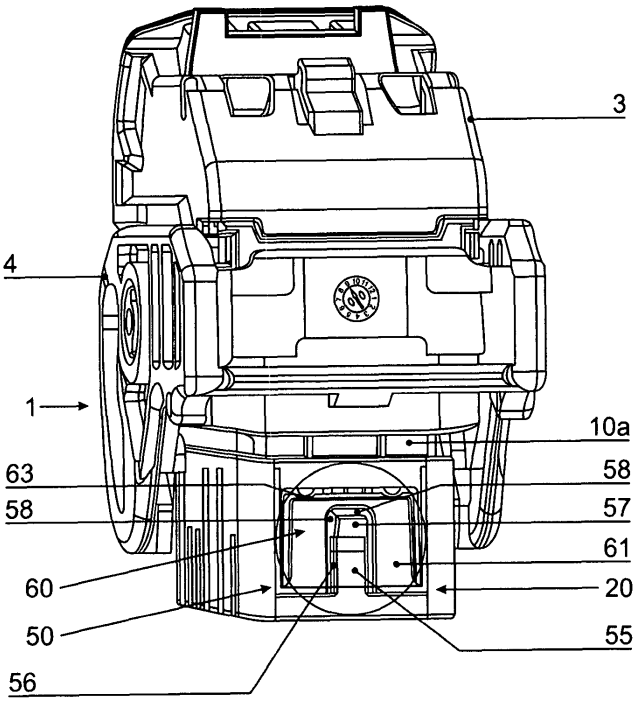

Fig. 1

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Description

Field of the Invention

[0001] The invention relates to a connector that is mateable with a complementary connector and comprises a connector housing, a plurality of terminals and a TPA member for terminal position assurance, and particularly to a connector wherein the terminals are latched in cavities of the connector housing and, when in a fully inserted position, can be locked by the TPA member. Connectors with the terminal position assurance feature are widely used in the automotive sector.

Background of the Invention

[0002] Connectors are often delivered in a so-called pre-assembled condition to customers, i.e. the terminals are not fully inserted in the cavities of the connector housing. For final use, it is important that the terminals are fully inserted to be properly seated in their respective cavity formation and that improper seating can be detected easily by the customer.

[0003] An electrical connector showing this feature is known from US-A-4,544,220. The connector housing is formed with a front housing part and a backward retainer housing part for the several terminals, the latter having engaging fingers situated radially about passages which the terminals extend through. Each terminal has a notch as a seating portion for the engaging fingers of the retainer housing part and a bearing portion of thicker cross section where the engaging fingers are spread apart when the terminals are inserted into the retainer housing part. If a single terminal is not fully inserted into the retainer, the engaging fingers around the respective passage remain spread apart which can be detected when assembling the connector front housing part which acts as a TPA member and has openings fitting around the engaging fingers when the same engage the seating portions of the terminals. Therefore, if one of the terminals is not properly seated, the front housing part cannot be properly latched with the retainer housing part. Whereas coupling of the connector with the complementary connector is prevented when any of the terminals is not fully inserted in the connector housing, the bearing sections which form beads around the terminals do not allow a small pitch in the arrangement of the terminals, that is, such a connector does not lend itself for miniaturization.

[0004] Female connectors each with a secondary lock are known from US 4,944,688 and US 4,973,268. The terminals each have a notch wherein latches of the connector housing may engage to fix the terminals in their fully inserted positions. The secondary lock has diamond-shaped pockets formed by diagonal wall sections that can lock the latches, if the terminals are correctly seated. If one of the terminals is not fully inserted, the corresponding latch is deflected and forms a stop for the secondary lock that cannot reach its final position. However, a complementary male connector may be mechanically coupled to the secondary lock of the female connector where correct electrical mating of the terminals is not ensured when the secondary lock is not fully inserted. A request exists that connectors should be prevented from being coupled when one of the terminals is not properly seated.

[0005] A connector having a TPA member is known from EP 0 967 694 A2 and comprises a receptacle connector housing having cantilever latch beams to latch respective terminals in the terminal cavities of the housing, if fully inserted. Otherwise the corresponding latch is flexed outwardly, and the TPA member having support ribs will engage the respective protruding latch and prevent complete insertion of the TPA member. The customer must take care whether this happened, or not, since there is no automatic TPA position detecting means inherent in the construction of the connector. In detail, there is no stop to prevent mechanical coupling of the complementary plug connector on the receptacle connector that has its TPA member not fully inserted. Incomplete insertion of the TPA member will lead to missing contact of the terminals of plug and receptacle connectors.

[0006] A further connector with a locking TPA member is known from WO 2006/034865 A1. The connector housing comprises a contact carrier module having slot-like cavities formed with recesses to accommodate respective terminals, and latching elements for latching the terminals. The TPA member is a cap that has webs in its interior to enter into the slot-like cavities of the connector housing so as to lock the terminals. The TPA member can be properly latched on the connector housing, if all terminals are fully inserted in the contact carrier module. In order to detect proper seating of the terminals, the TPA member is provided with a lever having a lever arm, the position thereof depends from the latch-position of the TPA member. When all terminals are fully inserted in the connector housing and the TPA member is latched thereon, the lever arm of the TPA member can be depressed by the complementary connector when the connectors are mated. If one of the terminals is not correctly seated, the TPA member cannot be properly latched onto the contact carrier module or connector housing, and the lever arm forms a stop that precludes mating of the complementary connector. Thus, an additional force is needed to depress the lever arm when coupling the connectors, additionally to what is normally required for mating the connectors.

[0007] A further connector with a locking TPA member is known from WO 2006/108610 A1. The connector housing forms slot-like cavities with terminal receiving chambers, each including a pawl for latching behind a stop on the terminal, and a guiding wall with a raising slope for pushing the terminal against the pawl, when the terminal is inserted in the housing. The TPA member is of box-like construction and includes locking lugs for blocking the respective pawls, once the connector is assembled. There is no TPA position detecting means that forms a

stop for preventing mating of connectors that are not correctly assembled.

[0008] A still further connector with a locking TPA member is known from FR 2,866,485 comprising a connector housing and a TPA member. The housing has terminal passages provided with pawls for latching the terminals, and the TPA member has fingers to block the pawls when the connector is completely assembled. No TPA position detecting means is provided.

[0009] A miniaturized connector is known (EP 1 351 339 A1) comprising a housing with six terminals in two rows, and a cap-shaped retainer with wall portions acting as a TPA member. The retainer has a front wall with six terminal openings and, associated thereto, six jig insertion holes for forcibly resiliently deforming the locking portion of a respective terminal. No probe access opening is provided.

[0010] A connector is known (EP 1 753 091 A1) that comprises a connector housing having terminal cavities with latching portions for the terminals, a retainer for locking the terminals and a front mask having terminal insertion openings and jig insertion openings. The front mask can be positioned in a proper position wherein the terminal insertion openings register to the terminal cavities, and shifted transversely to the terminal extending direction into a test position wherein the terminal insertion openings can be used as test openings. The retainer is inserted into a housing opening that extends transversely to the terminal extending direction and is therefore different to a TPA member of box-like construction.

Summary of the Invention

[0011] It is an object of the invention to construct a connector of the kind specified that allows a small pitch distance between the terminals.

[0012] It is another object of the invention to provide a connector of the kind specified with TPA position detecting means indicating whether, or not, the TPA member is correctly positioned on the connector.

[0013] It is a further object of the invention to provide means that prevents mating of the connectors, when the TPA member is not correctly positioned.

[0014] It is still a further object of the invention to provide a connector of the kind specified that can be mated with the complementary connector without any interference by TPA position detecting means when the connector has been correctly assembled.

[0015] It is still a further object of the invention to provide a connector of the kind specified that, in an assembled condition of the connector, forms compartments that firmly hold and retain the terminals, even if heavy vibrations occur.

[0016] It is still a further object of the invention to provide a connector of the kind specified that, in case of incomplete insertion of a terminal, does not suffer from an incorrect assembly of the TPA member, even if an excessive force is applied onto the TPA member.

[0017] It is still a further object of the invention to provide a connector of the kind specified that provides connectors comprising probe access openings and extraction tool openings separate from the terminal openings.

[0018] It is still a further object of the invention to provide a connector of the kind specified that is of a simple design.

[0019] It is still a further object of the invention of the kind specified that can be tested by a probe tool.

[0020] It is still a further object of the invention of the kind specified that allows to unlock and unlatch the terminals, if desired.

[0021] The invention is defined in the claims.

[0022] The connector of invention includes a connector housing, a plurality of terminals and a TPA member for terminal position assurance. The connector housing includes a plurality of cavity formations, each for receiving a respective one of the terminals. Each cavity formation has a latching element for latching a respective one of the terminals in a fully inserted position. The TPA member includes blocking elements which, in a final position of the TPA member, cooperate with the latching elements so as to lock the terminals which are in fully inserted positions, and when at least one of the terminals is not in its fully inserted position, the respective latching element cooperates with the TPA member so as to prevent the TPA member from reaching its final position. The connector also includes TPA position detecting means that forms a stop that prevents mechanical coupling of the connector with the complementary connector when the TPA member did not reach its final position.

[0023] According to a first aspect of the invention, the TPA position detecting means comprises guiding means on the connector housing and at least one spring finger with a stop member on the TPA member. In order to cooperate with the guiding means on the connector housing, each spring finger has at least one boss so as to guide the respective spring finger with its stop member from a stopping position wherein the stop prevents mating, to a final position wherein the stop member is in a unblocking position and mating of the connectors is made possible. Though the connector of invention has a TPA position detecting means, in the case of all terminals have been correctly seated in the connector housing, no interference is met when coupling the connectors together. The connectors can be mated with the usual force on the field of connectors.

[0024] In a preferred embodiment of the invention, the TPA member is of box-like construction having a hollow in it for encompassing a block-like portion of the connector housing, wherein the terminals are seated. Thus, the TPA member has a frontside wall with openings for male terminals of the complementary connector, a first pair of (larger) lateral sidewalls, a second pair of (smaller) lateral sidewalls, and an open side leading to the hollow for assembly on the connector housing. According to this embodiment of the invention, each sidewall of the second pair of sidewalls has a slot that defines the outlines of a

respective spring finger, with a pair of bosses extending into the slot. Thus, the TPA position detecting means is of simple construction: On the side of the TPA member, the TPA position detecting means is made up from wall portions of the TPA member, and on the side of the connector housing, the TPA position detecting means is formed by ribs having an undercut portion, so as to form a guiding groove for the bosses of the spring fingers. At the entry of the guiding groove, a cam is provided that defines the stopping position of the TPA member.

[0025] According to a second aspect of the invention, a block-shaped housing part is formed with slot-like cavities that have recesses to accommodate the terminals, and that are adapted to receive web-shaped blocking elements of the TPA member for locking the respective terminals. The blocking elements comprise ribs that function to additionally fix the terminals against vibrations, and, when the TPA member is assembled with the connector housing, to offer an inclined stop surface for a latching element that is deflected due to a terminal incompletely inserted, thus detecting incorrect assembly of the connectors.

[0026] According to a third aspect of the invention, the TPA member has three kinds of openings, namely terminal openings, probe access openings and extraction tool openings separated from one another. The construction of the connector is such that the probe tool and the extraction tool do not touch the terminal contact area, and that the extraction tool can only be inserted into its associated extraction tool openings.

Brief Description of the Drawings

[0027] Preferred embodiments are described with reference to the accompanying drawings.

Fig. 1 is a perspective view onto a small lateral side of a connector of invention,

Fig. 2 is a perspective view onto a large lateral side of the connector of Fig. 1 in mated condition with a complementary connector,

Fig. 3 is an enlarged view onto guiding means formed on a lower portion of the small lateral side of the connector housing of Fig. 1,

Fig. 4 is an enlarged section through a detail in Fig. 2 in a condition of preventing the mating of connectors,

Fig. 5 is a similar view to Fig. 4 for a condition of assembling the TPA member onto the connector housing,

Fig. 6 is a similar view to Fig. 4 for the condition of mating two connectors,

Fig. 7 is a part-sectional view through a connector housing showing the insertion of terminals in respective cavities,

Fig. 8 is a similar view to Fig. 7 with all terminals seated in their fully inserted positions,

Fig. 9 is a similar view to Fig. 7 with a TPA member in its locking position,

Fig. 10 is a perspective view onto the underside of the connector housing,

Fig. 11 is a perspective view onto the underside of a box-like TPA member,

Fig. 12 is a perspective view into the hollow of the box-like TPA member,

Fig. 13 is an enlarged detail from the interior of the connector showing terminal insertion,

Fig. 14 is a similar view to Fig. 13 showing latching of a terminal,

Fig. 15 shows latching of a terminal with a changed view of Fig. 14,

Fig. 16 is a part-sectional view through the connector housing with an extraction tool in action, and

Fig. 17 is an enlarged detail of Fig. 11.

Detailed Description

[0028] Figs. 1 and 2 show a connector assembly for automotive applications. The assembly includes a first or female connector 1 and a second or male connector 2 complementary to the first connector 1. Connector 1 includes a main housing 10, a TPA member 20 for terminal position assurance, a wire cap 3, a lever 4 and a peripheral seal 5 (Fig. 7). A plurality of conductors 30 (Figs. 7, 8, 9) extend through a seal cover and a matt seal (not shown) into the connector housing 10 and are terminated with receptacle terminals 31. These terminals 31 can be mated with plug terminals 6, 7 of the male connector 2 (Fig. 2). To that end, the lever 4 is provided with a slot 40, and the housing of the second connector 2 is provided with a peg 41 which, when the lever 4 is pivoted, cooperate to draw the second connector 2 relative to the first connector 1 and bring the terminals of both connectors together. However, such mating is only possible, if all of the terminals 31 are properly seated in the connector housing 10.

[0029] As best shown in Fig. 10, the connector housing 10 has a slotted front part 10a so as to form parallel walls 15. In the embodiment shown, two outer walls 15 and two inner walls 15 are provided. One side of each wall 15 comprises recesses 16 to accommodate the terminals 31 whereas the other side is "empty". The recesses 16 are separated from one another by webs extending in inserting direction of the terminals 31 and form cavity formations for these terminals. Empty sides face to one another separated by slots 17. All slots in the front part 10a are limited by lateral outer walls 18. The recesses 16 of the middle pair of walls 15 face to one another and include a middle or central cavity 11C, whereas outer cavities 11A, 11B are formed between the outer walls 15 and outer walls 23 of the TPA member 20. The cavities 11A, 11B and 11C are provided with latching elements 12 that are set back relative to the free ends of the walls 15.

[0030] Figs. 7 through 10 show how the terminals 31 are mounted in the recesses 16 of the slot-like cavities

11 of the connector housing part 10a to be enclosed therein. The terminals 31a at the right-hand side in Fig. 7 are about to be shifted into their rest positions which the left-hand side terminals 31 have already reached. As shown, the terminals 31a slide along straight wall surfaces of the recesses 16 that are parallel to one another and to the insertion or mounting direction of the terminals 31. On the other hand, the latching elements 12 extend into the space of the recesses 16 and are bent back when the terminals are inserted as at 12a in Fig. 7. When the terminals 31 reach their fully inserted positions, the latching elements 12 snap behind respective shoulders 32 of the terminals 31 so as to fix the terminals in their final positions.

[0031] The terminals 31 are of channel-like configuration with a U-shaped cross-section (see Figs. 13, 14), i. e. have side legs 31c, 31d and a connecting leg 31e. One end - the upper end in Figs. 7-9 and 15 - is fixed to a conductor or cable of a cable harness 30 such as by crimping. (In Figs. 13, 14, the crimping parts for the conductor are omitted for reasons of showing the U-shaped cross-section.) Within the channel of each terminal 31, a contact portion is provided for the respective plug terminal 6 or 7 of the male connector 2. In the embodiment shown, four rows of terminals 31 and three cavities 11A, 11B and 11C are formed. The female terminals 31 form a group A for mating with the male terminals 7 and a group B for mating with the terminals 6 of the complementary connector 2 (Fig. 2). The A group contains ten terminals of smaller type in four rows and the B group two terminals also in four rows.

Please note that the cavities 11 are not interrupted by any cross web, and encompass each a plurality of terminals 31. Furthermore, there is no slot separating group A from group B. The latch elements 12 are arranged in rows corresponding to the arrangement and size of the terminals 31 of the groups A and B.

[0032] As best shown in Figs. 13-16, each terminal 31 has a shoulder 32 that is formed by tabs from side legs 31c, 31d of the terminal wall. The tabs are bent to form a bridge crossing the channel of the respective terminal 31, that is, wall portions of the terminal form a closed profile at that place. Terminal 31a in Fig. 7 and Figs. 13-15 is about to be inserted into its cavity 11 and by doing so deflects the latching element 12a, which slides over the closed profile at the shoulder 32. When the terminal 31a is further inserted in its cavity 11, that is, shifted downwardly in Fig. 7, the respective latching element 12a snaps behind the shoulder 32 of the respective terminal 31a and fix it to some degree. This is done by the lowermost surface of the latching element 12, or as shown in Figs. 13, 14, by recess surfaces 12r at the free end of each latching element 12.

[0033] For the environment in an automotive vehicle, fixation by the latching elements 12 is not deemed sufficient, therefore the TPA member 20 is provided to lock the latching elements 12. The TPA member 20 includes blocking elements 21 which have the form of a web, as shown in Figs. 12 through 15. When a terminal such as 31a is not fully inserted in its cavity, and the latching element 12a is deflected, the blocking element 21 will meet the latching element 12a when trying to fully assemble the TPA member 20 onto the connector housing 10, as is demonstrated in Fig. 7. If however the terminals 31 take their fully inserted positions, as shown in Fig. 8, there is a narrow space 13 behind each latching element 12 wide enough to accommodate the free end of a respective blocking element 21 when the TPA member 20 is shifted into its final position as shown in Fig. 9. The blocking elements 21 are effective to lock the latching elements 12 and, therefore, also the terminals 31 in their respective fully inserted positions.

[0034] In the case of an automotive application of the connector, the TPA member 20 is preferably of box-like construction, as shown in Figs. 1, 11 and 12. As such, it has a bottom or frontside wall 22, a first pair of longer lateral sidewalls 23, a second pair of shorter lateral sidewalls 24 and an open side leading to the hollow interior 25 of the TPA member 20. The blocking elements 21 are arranged in rows 21A, 21B and 21C in the hollow interior 25 of the box-like TPA member and form webs or walls as best shown in Fig. 12. The length of each row or wall 21A, 21B 0r 21C measured between the shorter sidewalls 24 corresponds to a respective cavity 11A, 11B or 11C. In the area for the male terminals 7, the blocking elements include each a rib 26 and a fin 27, that extend in insertion direction of the terminals. Therefore, the ribs and fins 26, 27 function as a guide for the lateral sides 31c, 31d of the U-shaped terminals 31, particularly the rims thereof, when the TPA member 20 is shifted onto the housing block 10a.

[0035] At the level of the shoulder 32, the terminal 31 is of closed profile, so that the latching element 12b in Fig. 13 can slide over a flat surface of the terminal 31b at the shoulder 32 when the terminal 31b is moved into its fully inserted position. The latching elements 12 facing one another for the middle cavity 11C as shown in Figs. 13 and 14 are shaped rotary symmetric to one another and include each a wing 14 for sliding engagement with the outer wall of a respective terminal 31 in the region of the shoulder 32. This construction of the latching elements 12 and the blocking elements 21 with the guiding ribs 26 and fins 27 allow firm holding of the terminals 31 in the cavities 11 of the housing 10 where each cavity 11 is common for all terminals in a row.

[0036] The middle or central row 21C of blocking elements 21 show the ribs 26 staggered from one to the other side of the web formed by the blocking elements. Furthermore, the upper end surfaces 26a of the ribs 26 are inclined to one another in V-shape as best seen in Figs. 13-15. When a latching element 12a is deflected by virtue of a terminal 31a not being fully inserted, as shown in Figs. 7, 14 and 15, it takes a stop position with its blocking element 21, and the associated rib 26 with its inclined end surface 26a offers a further stop surface so that the latching element 12a cannot slip beyond the

element 21 when the TPA member 20 is pressed upwardly in Figs. 7 and 14, 15. Furthermore, the ribs 26 and fins 27 form holding surfaces for the legs 31c, 31d of the terminals 31 which are basically U-shaped in cross section. The slots between the ribs 26 and the fins 27 are useful to fix the legs 31c, 31d of the U-shaped terminals 31. For the middle row 21C of blocking elements 21, there are two rows of terminals 31 and two rows of latching elements 12.

[0037] The connector housing part 10a may be of a block-like construction (Fig. 10) that is made up of 2n parallel walls 15 (n = 1, 2, 3 ...). Each wall 15 is provided with a number of recesses 16 for accommodating respective terminals 31. The outer walls 15 are facing the respective inner sides of the larger lateral walls 23 of the TPA member, when the connector 1 has been assembled. The inner walls 15 are facing one another and include the (or each) middle cavity 11. Each outer wall 15 is facing one inner wall 15 to include a narrow empty space 17 therebetween for purpose of material savings and guiding ribs 22a of the TPA member 20 (Figs. 7-9). This construction allows dense packaging of the terminals 31 with no cross-extending walls of the main housing 10 between adjacent terminals in a row.

[0038] As was explained in the preceding description, the TPA member 20 may take a final position as shown in Fig. 9, when all terminals 31 are fully inserted, and an intermediate position, when anyone (31a) of the terminals is not fully inserted (Fig. 7). The connector of invention includes TPA position detecting means 50 that is explained with the help of Figs. 3 through 6 and 10 through 12. The TPA position detecting means 50 is made up of two main components, namely guiding means 51 (Figs. 3-6) on each small lateral side of the connector housing part 10a, and each a spring finger 55 (Figs. 1, 4, 5, 6, 11, 12) formed on each small lateral side 24 of the TPA member 20. Guiding means 51 include a pair of parallel ribs 52 that extend along the small lateral side 18 of the connector housing part 10a, each having an undercut 52a facing one another so as to form a guiding groove 53 therebetween. At the entry side of the groove 53, a cam 54 is provided. The spring finger 55 is part of the TPA member 20 and made up from wall portions of the smaller lateral side 24 (Figs. 1, 11 and 12). An U-shaped slot 56 in the wall of the box-shaped TPA member 20 separates the spring finger 55 from the TPA member wall leaving a bridge that connects the spring finger with the TPA member wall. The spring finger 55 is provided with a stop element 57 and a pair of bosses 58 that extend into the slot 56. At the level of the bosses 58, the width of the spring finger corresponds to the width w of the groove 53 (Fig. 3). The bosses 58 may slip into and along the respective slots offered by the undercut portions 52a.

[0039] In the intermediate position of the TPA member 20 (Figs. 7 and 8), the spring finger 55 takes a position shown in Fig. 4, that is, the inner body surface of the spring finger 55 rests upon the cam 54, and the bosses 58 are clear off the slots 52a. In this situation, the stop element 57 prevents shifting of the connector 2 into its mating position. Thus, the spring finger 57 "detects" the TPA intermediate position and, therefore, a terminal 31a not fully inserted.

[0040] When the terminals 31 are fully inserted, as shown in Fig. 8, the TPA member 20 can be moved into its final position. Fig. 5 shows the start of this movement. The spring finger 55 has an inward bias so that the bosses 58 enter into the groove 53, and the spring fingers 55 are bent inwardly. With the further movement of the TPA member 20, the bosses 58 get into the slots 52a as shown in Fig. 6. The spring fingers 55 are fully bent inwardly when the TPA member 20 reaches its final position. As shown, the stop element 57 is fully retracted and does not offer any interference to the second complementary connector 2 when the same is mated with the first connector 1.

[0041] TPA latching means 60 are provided on the TPA member 20 and the connector housing part 10a, respectively, to latch the TPA member in its final position onto the connector housing 10. The TPA latching means 60 include each a flexible tongue 61 provided with dogs 62 (Fig. 12) on the TPA member and catches 65 (Fig. 3) on the smaller lateral side 18 of the connector housing part 10a. The latching tongue 61 is made up from wall portions of the TPA member 20, separated from the main wall portions by a slot 63. When the TPA member 20 is shifted into its final position, the dogs 62 snap behind the catches 65, and the TPA member is latched onto the connector housing portion 10a.

[0042] As shown in Figs. 11, 16 and 17, the front wall 22 of the TPA member 20 is provided with a number of openings, among them openings 71A for the passage of the male terminals 7, opening 71B for the male terminals 6, openings 72 for terminal probing and openings 73 for an extraction tool 75. The openings 71A, 71B, 72 and 73 do not merge with one another. The openings 71A register to the recesses 16 for the female terminals 31 of group A and the openings 71B register to the recesses for the group B terminals. Similarly, the openings 72 register to an outer wall of each respective terminal 31 (see Fig. 9) and openings 73 register along an outer slide surface of each respective terminal 31 (see Fig. 16). Size and shape of the openings 71A, 71B, 72 and 73 are made different to one another in order to avoid mistakes when mating connectors or using the probe or the extraction tool. Particularly, the openings 73 have a basically triangular shape or L- or T-shape with one side larger than the sides of the square openings 71A or 71B, or the diameter of the circular probe openings 72. Accordingly, the cross-sectional dimensions of the extraction tool 75 are bigger than the dimensions of the passages 71A for the male terminals 7. The terminals 31 are shaped and arranged such that electrical terminal probing can be done through openings 72 without touching the contact portion of the terminal, which is inside the legs 31c, 31d of a respective terminal 31. Similarly, when the TPA

member 20 is pulled into the position shown in Fig. 8, where the spaces 13 are clear from the blocking elements 21, the extraction tool 75 (Fig. 16) lifts the latch 12 without touching the terminal contact area of terminal 31 as best seen in Fig. 16. Thereupon, the terminal so unlatched can be extracted by pulling on the appropriate terminal conductor or by pushing onto the appropriate terminal 31.

[0043] The front wall 22 of TPA member 20 has further openings 74 (Fig. 11) for an extraction tool (not shown) for bending back the spring fingers 55 and/or the flexible tongue 61 for removing the TPA member 20 from the connector housing 10.

[0044] It now can be understood that the objects named in the specification introduction can be fulfilled, namely that a small pitch distance between the terminals can be kept, that correct positioning of the TPA member can be detected, that in case of incorrect positioning of the TPA member, the connectors are prevented from mating, and that in case of correct positioning of the TPA member, the connector can be mated without any interference.

[0045] The embodiments described can be modified without departing from the scope of the claims.

Claims

1. A connector (1)
mateable with a complementary connector (2), comprising

a connector housing (10),
a plurality of terminals (31), and
a TPA member (20) for terminal position assurance, the connector housing (10) including
a plurality of cavity formations, each for receiving a respective one of the terminals (31),
each a latching element (12) being provided for each cavity formation for latching a respective one of the terminals (31) in a fully inserted position,
the TPA member (20) including
locking elements (21) which, in a final position of the TPA member,
cooperate with the latching elements (12) so as to lock the terminals (31) which are in fully inserted positions, and
when at least one of the terminals (31) is not in its fully inserted position, the respective latching element (12) cooperates with the TPA member (20) so as to prevent the TPA member from reaching its final position,
the connector (1) also including TPA position detecting means (50) that forms a stop that prevents mating of the connectors (1, 2) when the TPA member (20) is in an intermediate position,
wherein the TPA position detecting means (50) comprises
guiding means (51) on the housing (10), and
at least one spring finger (55) on the TPA member (20),
the spring finger (55) includes a stop element (57) and
at least one boss (58) for cooperation with the guiding means (51)
so as to guide the spring finger (55) with its stop element (57) from a stopping position wherein the stop element (57) prevents mating,
to a final position wherein the stop element (57) is in an unblocking position so as to enable mating of the connectors (1, 2).

2. The connector of claim 1
wherein the TPA member (20) is of box-like construction having a hollow (25) in it and comprising
a frontside wall (22) with openings (71) for male terminals (7) of the complementary connector (2),
a first pair of lateral sidewalls (23),
a second pair of lateral sidewalls (24) and
an open side for assembly on the connector housing (10),
each sidewall (24) of the second pair having a slot (56) that defines the outlines of a respective spring finger (55) with a pair of bosses (58) extending into the slot (56).

3. The connector of claim 2
wherein the connector housing (10) has a block-like portion (10a) corresponding in shape to the hollow (25) of the TPA member (20), the block-like portion (10a) on its outer side comprising a pair of parallel ribs (52) with a groove (53) therebetween, and a cam (54) arranged at an entry side of the groove (53), the ribs (52) having an undercut portion (52a) and together with the groove (53) form guideways so that the pair of bosses (58) of each spring finger (55) are guided along the guideways when the TPA member (20) is shifted into its final position.

4. The connector of claim 3
wherein the cam (54) at the entry side of the groove (53), in cooperation with the spring finger body (55), defines the stopping position of the TPA member (20).

5. The connector of any of claims 2-4
wherein each lateral sidewall (24) of the second pair comprises a second slot (63) so as to form a flexible tongue (61) from wall portions of the second pair sidewall (24), the flexible tongue (61) having latching means (62) for cooperation with latching means (65) on the connector housing (10) to latch the TPA member (20) in its final position.

6. The connector of any of claims 2-5
wherein the frontside wall (22) of the TPA member

(20) comprises openings (74) for entry of an extraction tool so as to unlatch the TPA member (20) from engagement with the connector housing (10).

7. The connector of any of claims 1-6
wherein the blocking elements (21) of the TPA member (20) form walls (21A, 21B, 21C) comprising ribs (26) extending therefrom, each rib (26) having an inclined end surface (26a) facing a respective latching element (12) for engaging the same when such latching element (12a) is deflected by virtue of a terminal (31a) not fully inserted.

8. The connector of claim 7
wherein the terminals (31) are of U-shaped configuration having side legs (31c, 31d) and
wherein the blocking elements (21) comprise fins (27) that, together with the ribs (26) form slots therebetween to guide the side legs (31c, 31d) of the terminals (31) in their fully inserted positions.

9. The connector of any of claims 3-8
wherein the housing block-like portion (10a) include slot-like cavities (11A, 11B, 11C) between parallel walls (15), each being provided with a number of recesses (16) for accommodating the respective terminals (31), and
wherein the latching elements (12) and the blocking elements (21) extend in the slot-like cavities (11A, 11B, 11C) from opposite sides of the cavities (11A, 11B, 11C).

10. A connector (1)
mateable with a complementary connector (2), comprising

a connector housing (10),
a plurality of terminals (31), and
TPA member (20) for terminal position assurance, the connector housing (10) including
a plurality of cavity formations, each for receiving a respective one of the terminal (31),
each a latching element (12) being provided for each cavity formation for latching a respective one of the terminals (31) in a fully inserted position,
the TPA member (20) including
blocking elements (21) which, in a final position of the TPA member,
cooperate with the latching elements (12) so as to lock the terminals (31) which are in fully inserted positions, and
when at least one of the terminals (31) is not in its fully inserted position, the respective latching element (12) cooperates with the TPA member (20) so as to prevent the TPA member from reaching its final position,
the connector (1) also including TPA position detecting means (50) that forms a stop that prevents mating of the connectors (1, 2) when the TPA member (20) is in an intermediate position,
wherein the connector housing (10) comprises
a housing part forming at least one middle cavity (11C) and
together with the TPA member (20)
two outer cavities (11A, 11B) that are slot-like and formed with recesses (16) to accommodate respective terminals (31),
wherein the blocking elements (21) of the TPA member (20)
form walls (21A, 21B, 21C) in length corresponding to each respective cavity (11A, 11B, 11C), and
at least some of the blocking elements (21) each has a rib (26) so as to form compartments for the terminals (31) when the TPA member (20) takes its final position.

11. The connector of claim 10
wherein the blocking elements (21) of the TPA member (20) also include fins (27) that, together with respective ribs (26), extend in insertion direction of the terminals (31) parallel to the ribs (26) of the respective blocking element (21) so as to form respective slots and to give further support to the terminals (31) when the TPA member (20) is correctly mounted with the connector housing (10).

12. The connector of claim 10 or 11
wherein the ribs (26) of the blocking elements (21) each has an inclined end surface (26a) facing a respective latching element (12) so that, when a terminal (31a) is not fully inserted and the latching element (12a) cooperating therewith is deflected, such latching element (12a) finds a stop on the inclined surface (26a) of that rib that cooperates with the deflected latching element (12a).

13. The connector of any of claims 10-12
wherein the TPA member (20) is of box-like construction having a hollow (25) in it, and
wherein said walls (21A, 21B, 21C) formed of the blocking elements (21) are arranged in said hollow (25).

14. The connector of claim 13
wherein the connector housing (10) has a block-like portion (10a) corresponding in shape to the hollow (25) of the TPA member (20) and including lateral sidewalls (18) that extend perpendicular to said cavities (11A, 11B, 11C), and a number of parallel walls (15) that extend between said lateral sidewalls (18).

15. The connector of claim 14
wherein the connector housing (10) comprises even-numbered (2n) parallel walls (15), each having a first

side shaped with a plurality of recesses (16) forming the cavity formations and a second side, the first side facing a respective cavity (11) for accommodating terminals (31) in a row.

16. The connector of any of claims 11-15 wherein the terminals (31) are of U-shaped configuration having legs (31c, 31d) that fit into the slots between ribs (26) and fins (27) and, in the space between the legs (31c, 31d, 31e), define a terminal contact area.

17. The connector of claim 16 wherein the TPA member (20) comprises terminal openings (71) for plug terminals (6, 7) of the complementary connector (2) that are arranged registering to the respective terminal contact areas of the terminals (31), and probe access openings as well as extraction tool openings (73) that are arranged out of register to the terminal contact areas.

18. A connector (1) mateable with a complementary connector (2), comprising
a connector housing (10),
a plurality of terminals (31), each including a terminal contact area, and
a TPA member (20) for terminal position assurance,
the connector housing (10) including
a plurality of cavity formations,
each for receiving a respective one of the terminal (31),
each a latching element (12) being provided for each cavity formation for latching a respective one of the terminals (31) in a fully inserted position,
the TPA member (20) including
blocking elements (21) which, in a final position of the TPA member,
cooperate with the latching elements (12) so as to lock the terminals (31) which are in fully inserted positions, and
when at least one of the terminals (31) is not in its fully inserted position, the respective latching element (12) cooperates with the TPA member (20) so as to prevent the TPA member from reaching its final position,
wherein the TPA member (20) is of box-like construction comprising a front wall (22) with a number
of terminal openings (71),
of probe access openings (72) and
of extraction tool openings (73),
the terminal openings (71) being arranged in first rows and
the probe access openings (72) as well as the extraction tool openings (73) being arranged in second rows,
are arranged relative to the terminals (31) so that a probe tool or
an extraction tool (75) do not touch the terminal contact area, if properly inserted into its respective opening (72, 73).

19. The connector of claim 18 wherein the terminal openings (71), the probe access openings (72) and the extraction tool openings (73) are of a size and shape different to one another such that the extraction tool (75) does not fit into the terminal openings (71) or the probe access openings (72).

20. The connector of claim 19 wherein the terminal openings (71) are square openings, the probe access opening (72) are circular openings and the extraction tool openings (73) are basically triangular openings.

Amended claims in accordance with Rule 137(2) EPC.

1. A connector (1)
mateable with a complementary connector (2), comprising
a connector housing (10),
a plurality of terminals (31), and
a TPA member (20) for terminal position assurance,
the connector housing (10) including
a plurality of cavity formations, each for receiving a respective one of the terminals (31),
a latching element (12) being provided for each cavity formation for latching a respective one of the terminals (31) in a fully inserted position,
TPA latching means (60) provided on the TPA member (20) and the connector housing (10), respectively, to latch the TPA member in its final position onto the connector housing, the TPA member (20) including
locking elements (21) which, in the final position of the TPA member, cooperate with the latching elements (12) so as to lock the terminals (31) which are in fully inserted positions, and
when at least one of the terminals (31) is not in its fully inserted position, the respective latching element (12) cooperates with the TPA member (20) so as to prevent the TPA member from reaching its final position,
the connector (1) also including TPA position detecting means (50) that forms a stop that prevents mating of the connectors (1, 2) when the TPA member (20) is in an intermediate position,
characterized in that
the TPA latching means (60) is arranged separated from the TPA position detecting means (50),
the TPA position detecting means (50) comprises

- guiding means (51) forming a guiding groove (53) on the housing (10), and

- at least one spring finger (55) having an inward bias,

wherein the spring finger (55) includes

- a stop element (57) for the complementary connector (2) and
- at least one boss (58) for cooperation with the guiding groove (53) of the guiding means (51),
- so as to guide the boss (58) of the spring finger (55) into and along the guiding groove (53), and
- when a terminal (31a) is not fully inserted, the TPA member (20) with its stop element (57) takes a stopping position wherein the stop element (57) prevents mating, and
- when all terminals (31) are fully inserted, shifting of the TPA member (20) into its final position is possible so that stop element (57) is in an unblocking position so as to enable mating of the connectors (1, 2).

2. The connector of claim 1
wherein the TPA member (20) is of box-like construction having a hollow (25) in it and comprising
a frontside wall (22) with openings (71) for male terminals (7) of the complementary connector (2),
a first pair of lateral sidewalls (23),
a second pair of lateral sidewalls (24) and
an open side for assembly on the connector housing (10),
each sidewall (24) of the second pair having a slot (56) that defines the outlines of a respective spring finger (55) with a pair of bosses (58) extending into each slot (56).

3. The connector of claim 2
wherein the connector housing (10) has a block-like portion (10a) corresponding in shape to the hollow (25) of the TPA member (20), the block-like portion (10a) on its outer side comprising a pair of parallel ribs (52) with the guiding groove (53) therebetween, and a cam (54) arranged at an entry side of the guiding groove (53), the ribs (52) having an undercut portion (52a) and together with the guiding groove (53) form guideways so that the pair of bosses (58) of each spring finger (55) are guided along the guideways when the TPA member (20) is shifted into its final position.

4. The connector of claim 3
wherein the cam (54) at the entry side of the guiding groove (53), in cooperation with the spring finger body (55), defines the stopping position of the TPA member (20).

5. The connector of any of claims 1-4
wherein the TPA latching means (60) include a flexible tongue (61) provided with dogs (62) and formed from wall portions of the TPA member (20), and catches (65) on the connector housing (10).

6. The connector of claim 5 related to claim 2-4
wherein each lateral sidewall (24) of the second pair of lateral sidewalls (24) comprises a second slot (63) so as to form the flexible tongue (61) from wall portions of the second pair of lateral sidewalls (24).

7. The connector of any of claims 2-6
wherein the frontside wall (22) of the TPA member (20), close to each second pair of lateral sidewalls (24), comprises openings (74) for entry of an extraction tool so as to unlatch the TPA member (20) from engagement with the connector housing (10).

8. The connector of any of claims 1-7
wherein the blocking elements (21) of the TPA member (20) form walls (21A, 21B, 21C) comprising ribs (26) extending therefrom, each rib (26) having an inclined end surface (26a) facing a respective latching element (12) for engaging the same when such latching element (12a) is deflected by virtue of a terminal (31a) not fully inserted.

9. The connector of claim 8
wherein the terminals (31) are of U-shaped configuration having side legs (31c, 31d) and
wherein the blocking elements (21) comprise fins (27) that, together with the ribs (26) form slots therebetween to guide the side legs (31c, 31d) of the terminals (31) in their fully inserted positions.

10. The connector of any of claims 3-9
wherein slot-like cavities (11A, 11B, 11C) are formed between parallel walls (15) of the housing block-like portion (10a) and towards each lateral sidewall (23) of the first pair of sidewalls (23), each wall (15) being provided with a row of recesses (16) for accommodating the respective terminals (31), and
wherein the latching elements (12) and the blocking elements (21) extend in the slot-like cavities (11A, 11B, 11C) from opposite sides of the cavities (11A, 11B, 11C).

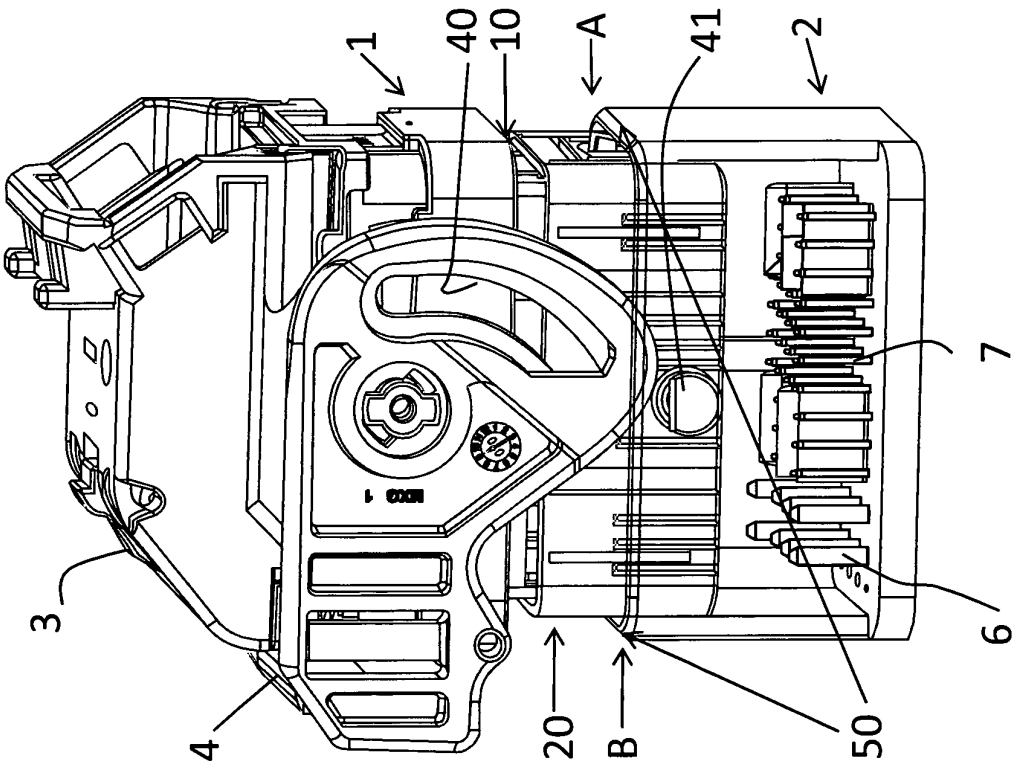


Fig. 2

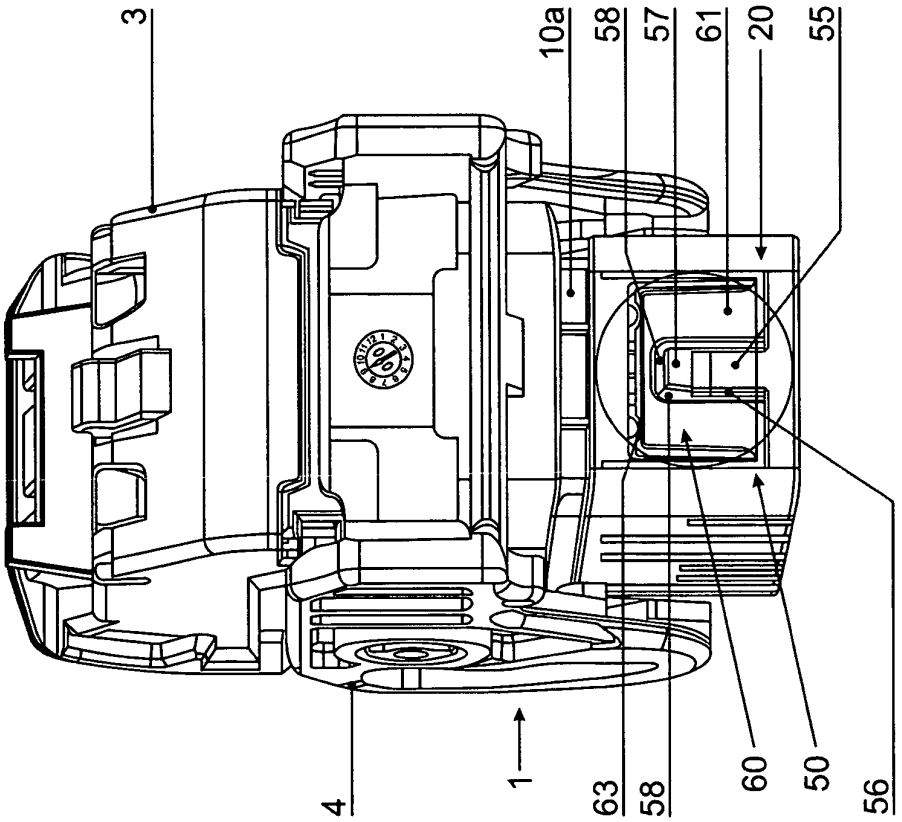


Fig. 1

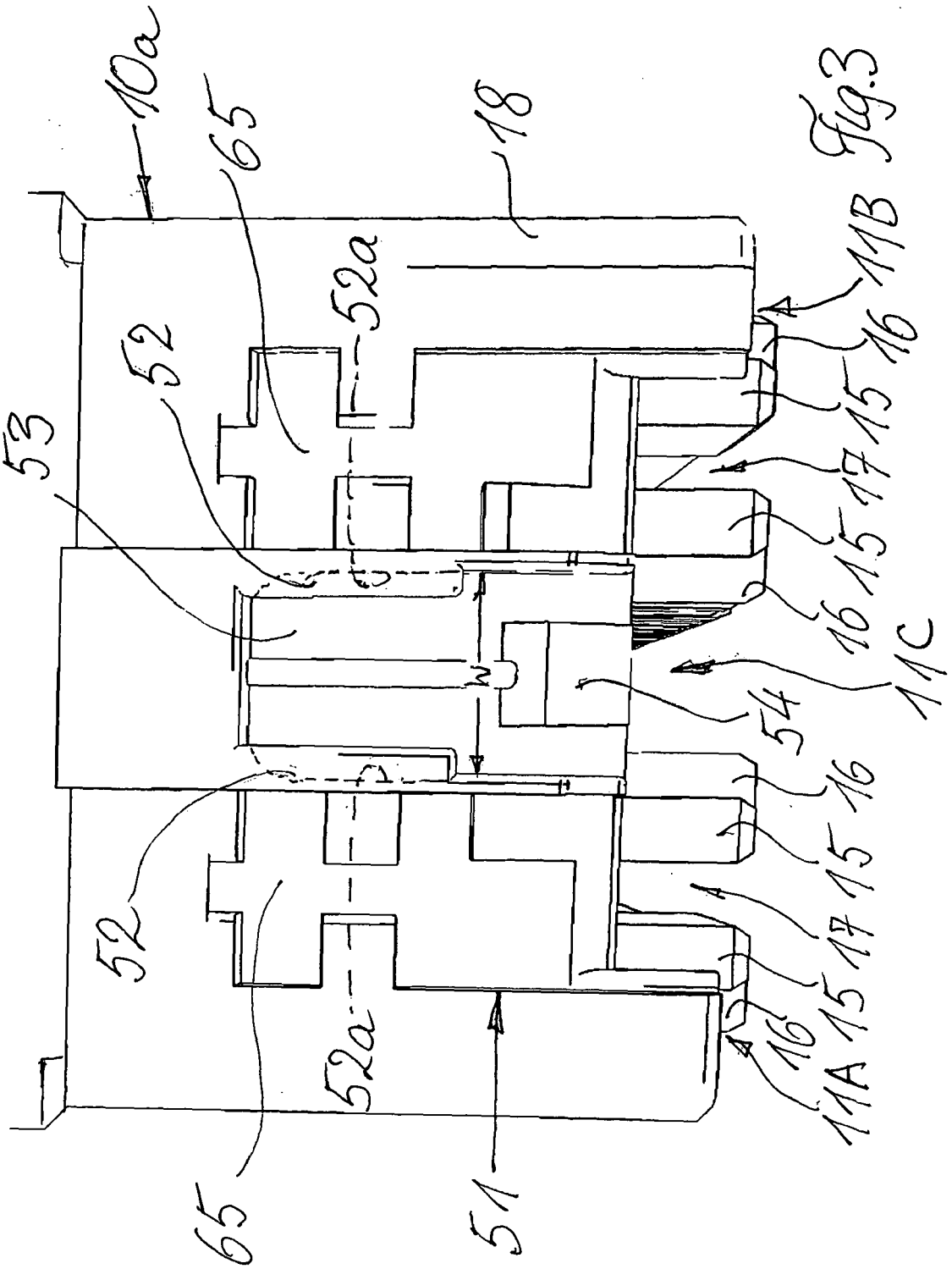

10a
65
18
52a
52
53
11B
16
15
17
15
16
15
16
11C
54
52
52a
65
51
16
15
17
15
16
11A

Fig.3

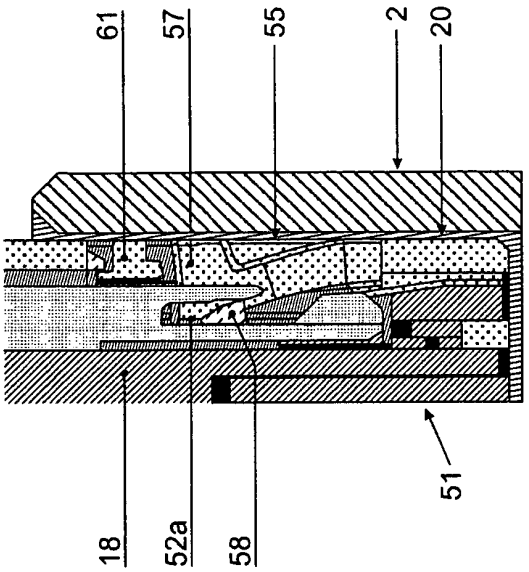


Fig. 6

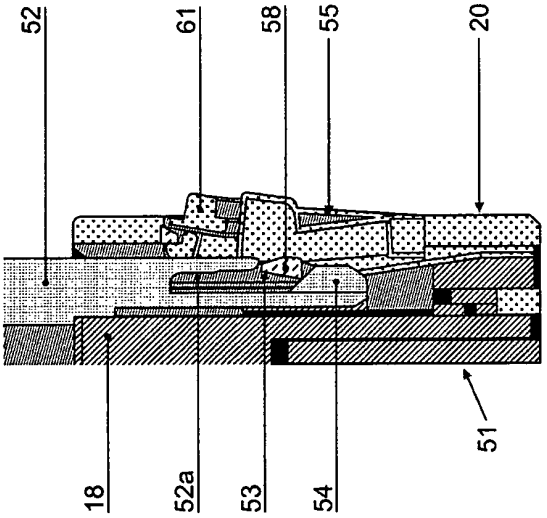


Fig. 5

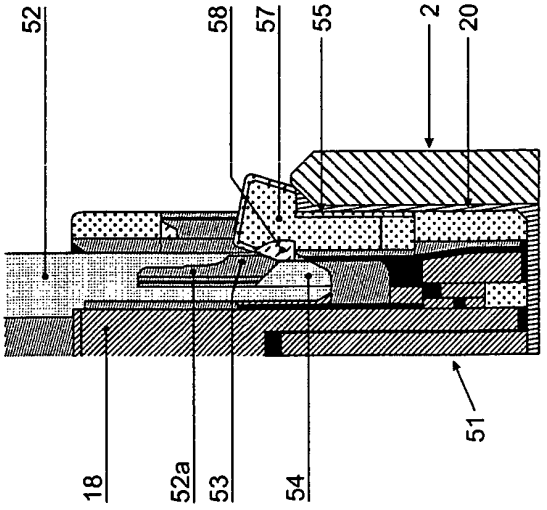


Fig. 4

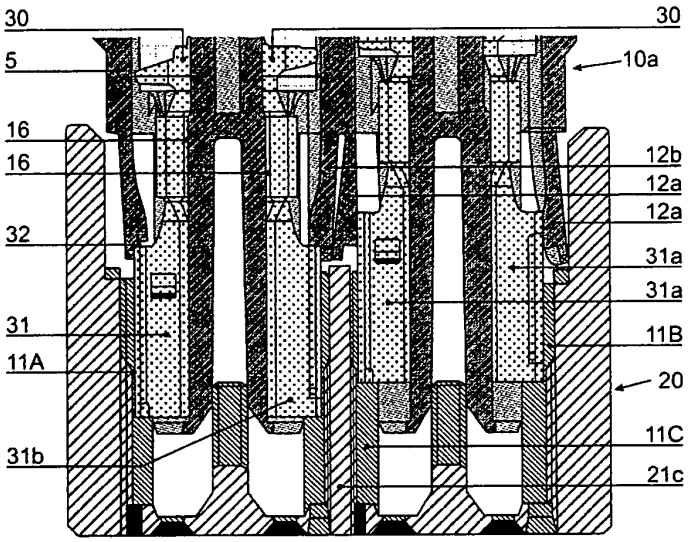


Fig. 7

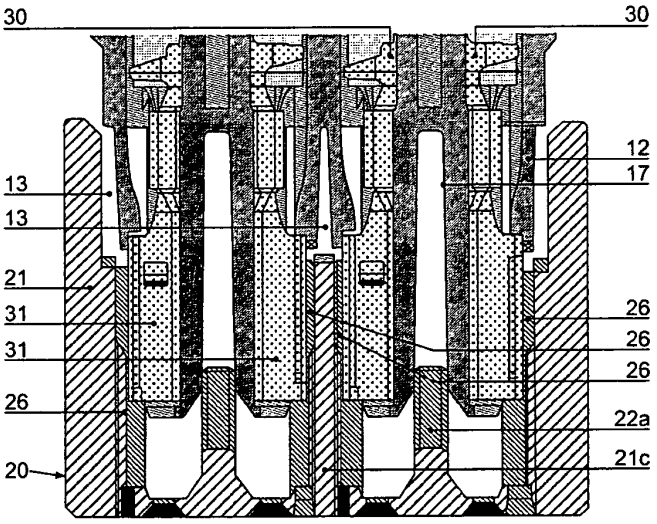


Fig. 8

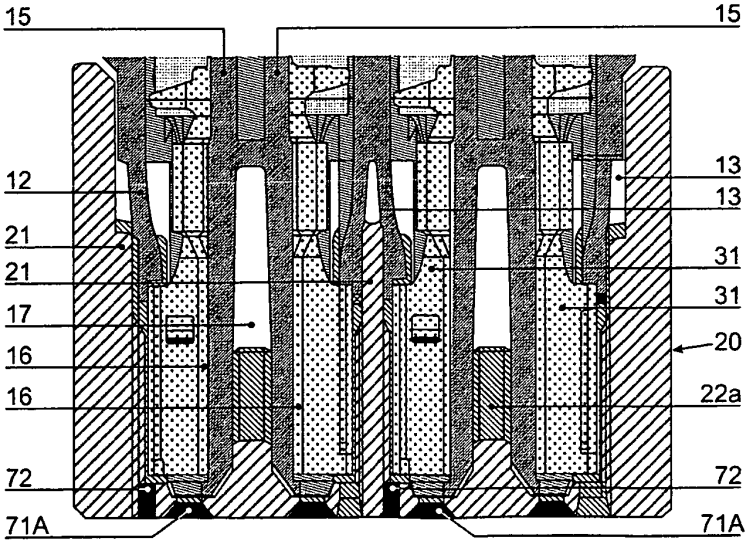


Fig. 9

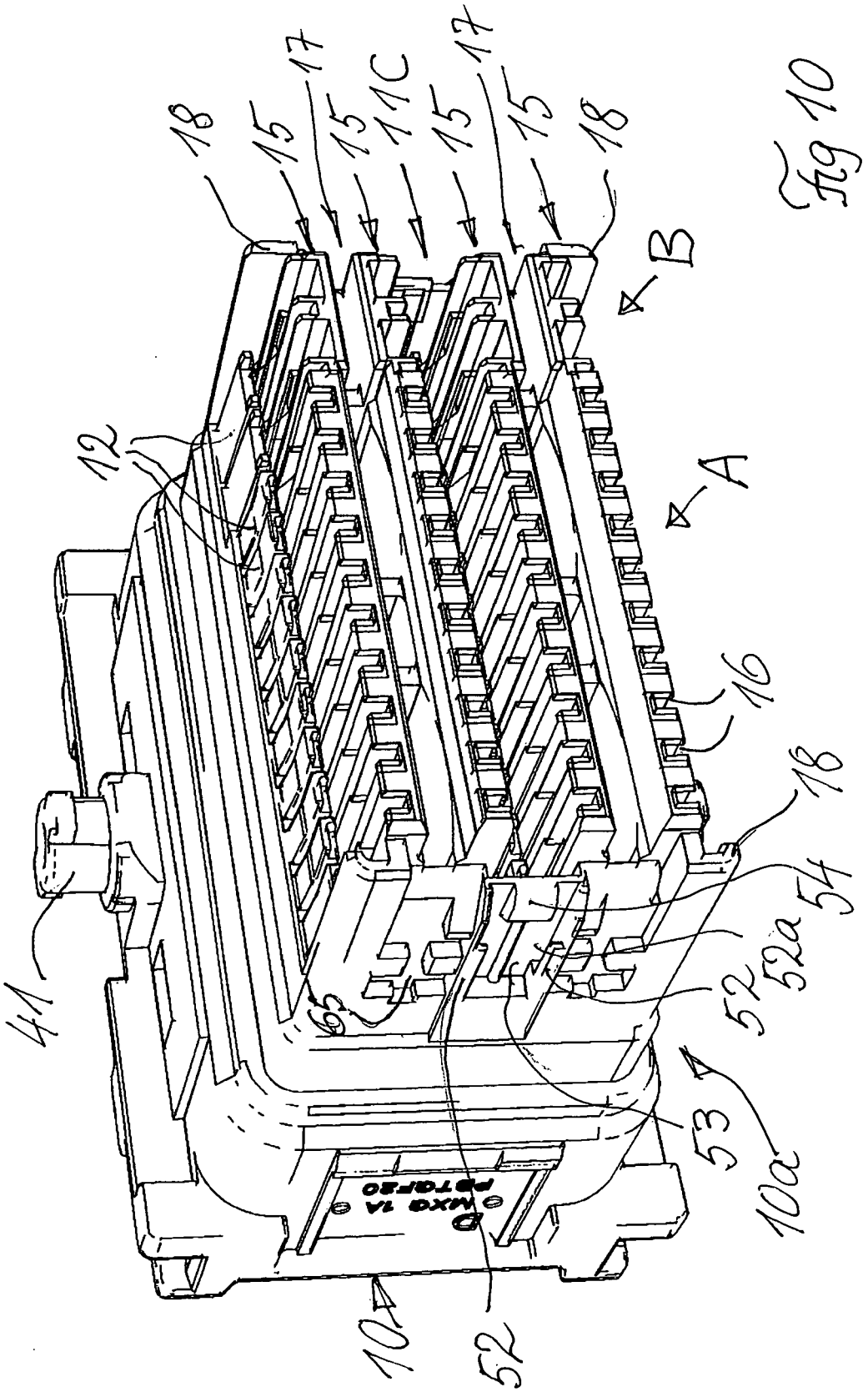


Fig 10

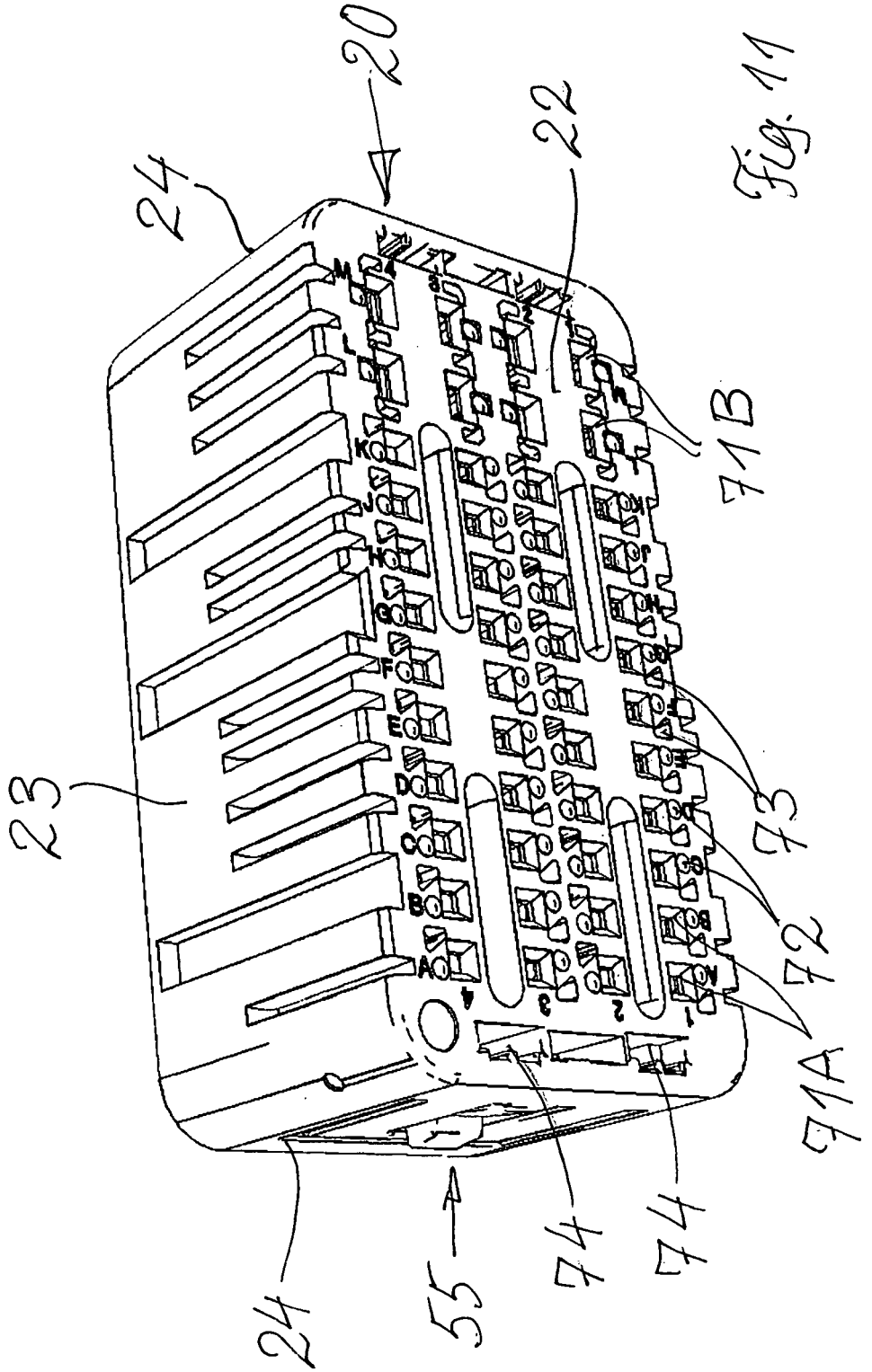


Fig. 11

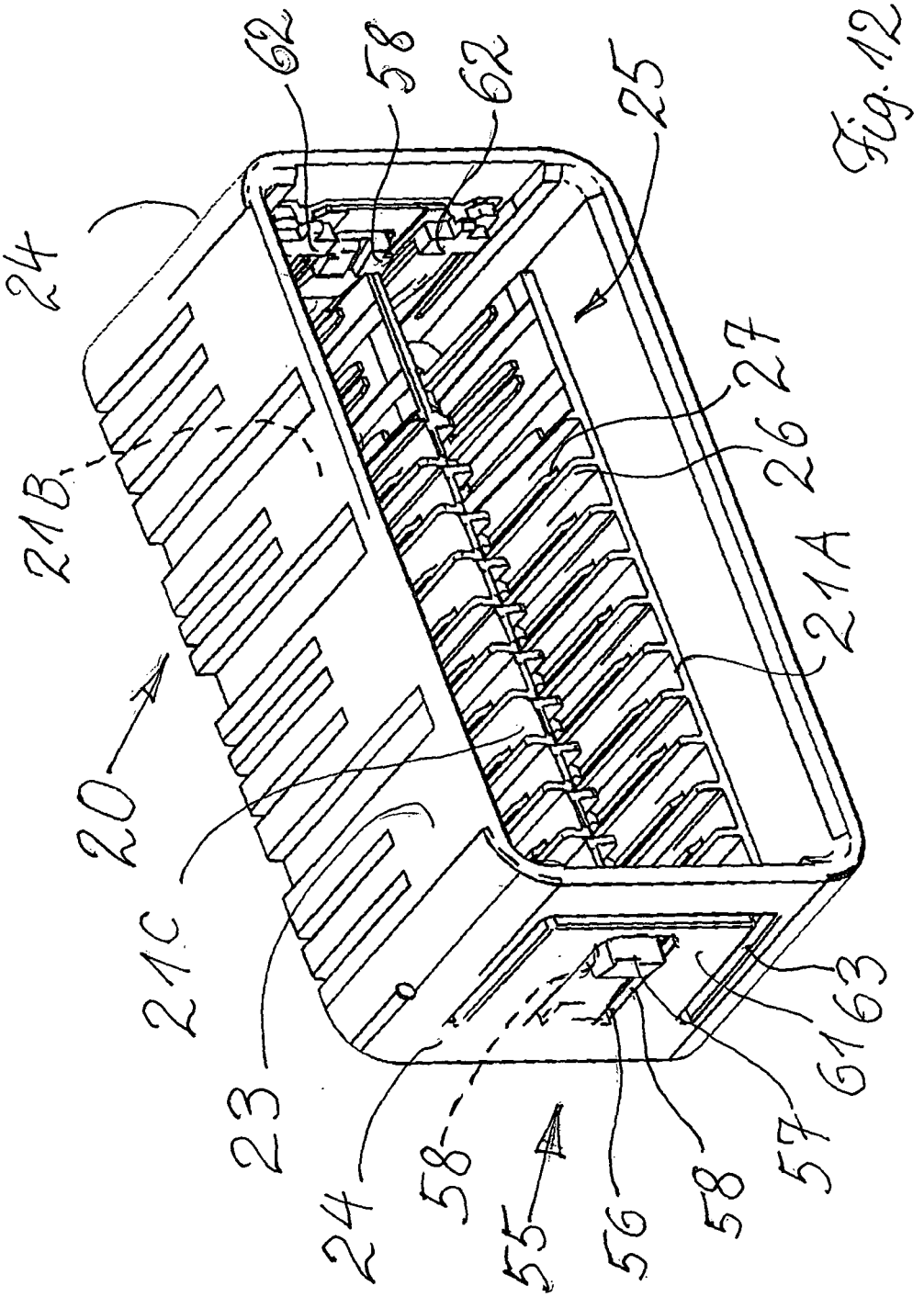


Fig. 12

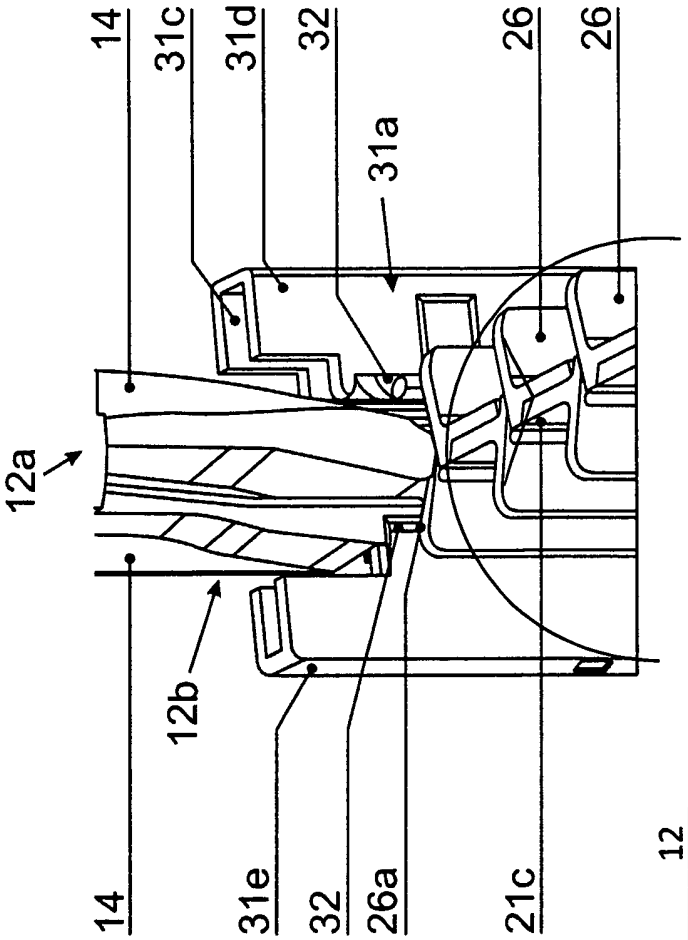

14
31c
31d
32
31a
26
26
12a
12b
14
31e
32
26a
21c

Fig. 14

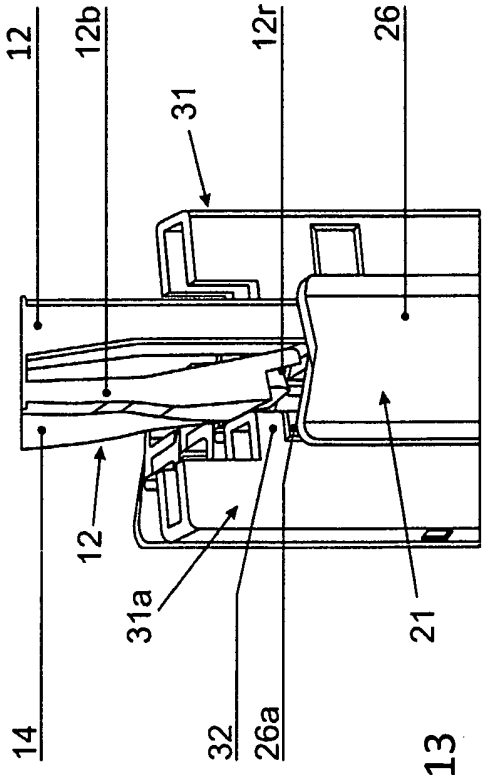
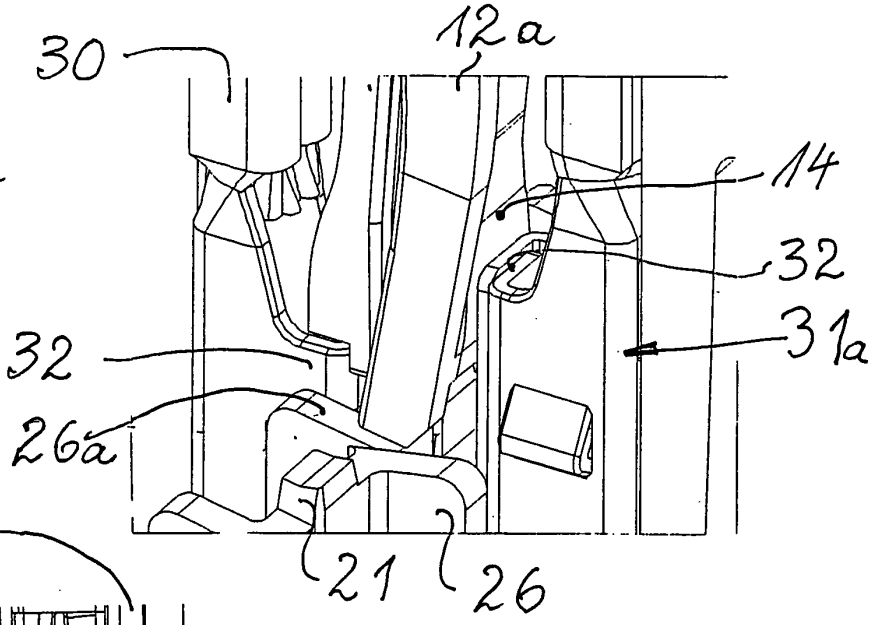

12
12b
31
12r
26
12
31a
14
32
26a
21

Fig. 13

Fig. 15



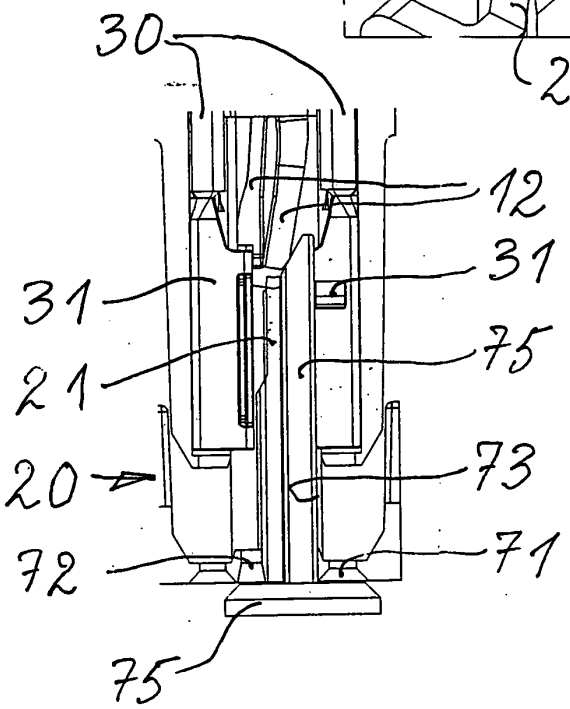


Fig. 16

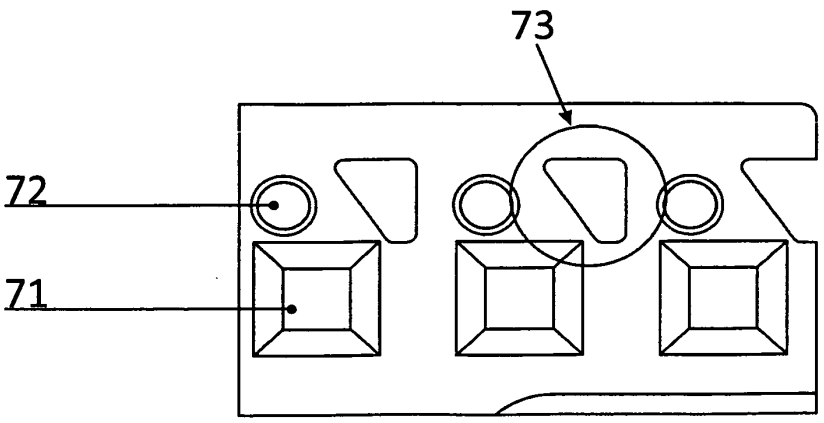


Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 08 00 7987

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* the whole document *	17-20	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 October 2008	Jiménez, Jesús

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 08 00 7987

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 08 00 7987

The Search Division considers that the present European patentapplication does not comply with the requirements of unity of invention and relates to severalinventions or groups of inventions, namely:

1. claims: 1-9

   A connector comprising a housing, a TPA member and a TPA position detecting means having guiding means and at least one spring finger with a stop element and a boss.

   ---

2. claims: 10-17

   A connector comprising a housing, a TPA member and a TPA position detecting means, the housing and the TPA member forming cavities to accommodate the terminals.

   ---

3. claims: 18-20

   A connector comprising a housing and a TPA member having probe access openings.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 00 7987

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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30-10-2008

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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