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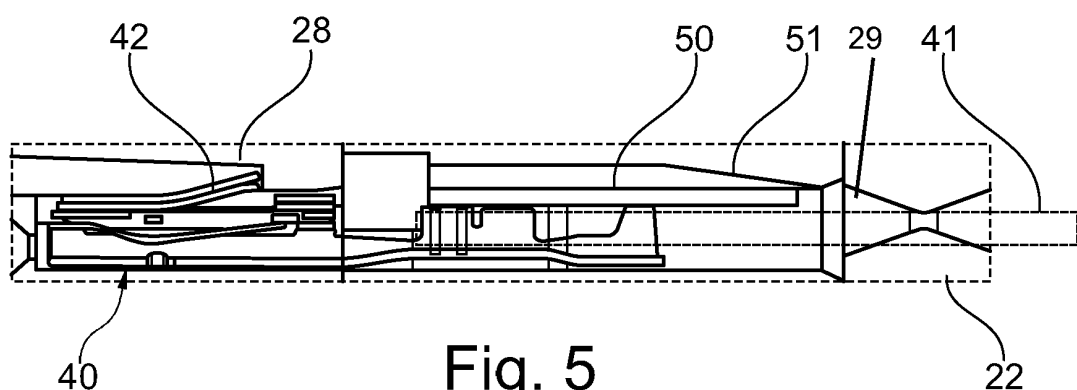
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(54) **Improved connector assembly with mat seal**

(57) The present invention relates to an electrical connector assembly (10), comprising a housing (20) with a plurality of cavities (50) for the reception of electrical contact terminals (40) and a mat seal (22) to seal off the terminals. The housing (20) is adapted such that the ter-

minals (40) can be mounted through the seal holes (29) of the mat seal into said cavities (50) and so that it is possible to remove the terminals (40) again from the housing (20) through said mat seal (22).



Description

Technical field of the invention

[0001] The present invention relates to electrical connector assemblies comprising a plurality of contact terminals, and a mat seal having a corresponding plurality of seal holes, through which the contact terminals are inserted.

Background of the invention

[0002] Electrical connector assemblies often have to be sealed off against the environment, as for example sealed off against moisture or water, to prevent electrical failure. In particular in automotive applications, connector systems are required, which have a large number of signal contacts, like for example more than 50 or more than 80 signal contacts in a single connector housing, which nevertheless have to be water proof to some extend due to for example the application of such connectors inside the engine compartment of a vehicle. To effectively and efficiently seal off a large number of contacts, i.e. electrical wires or cables and the corresponding contact terminals, so called block seal or mat seal devices were developed. A block or mat seal is usually a silicon or rubber element comprising a plurality of seal holes formed therethrough in a juxtaposed relation, through which wires or cables extend.

[0003] Document WO 2013/031088 A1 discloses for example a waterproof connector including a housing in which a large number of electrical contact terminals connected with corresponding electric wires are housed. A mat seal is installed into an opening of the housing through which the wires, with contact terminals attached thereto, are inserted. A mat seal holder fixes the mat seal onto the housing and the contact terminals with the attached wires are then fixed in a suitable manner inside of the connector housing. To this end, the connector housing comprises a plurality of cavities adapted to receive the contact terminals therein and the seal holes of the mat seal are adjacent to and aligned with these cavities.

[0004] From US 5,836,788 another waterproof connector is known which uses a mat seal made of a soft, elastic material such as rubber, comprising a plurality of juxtaposed wire seal holes formed therethrough. The mat seal is mounted into an opening of a connector housing. The wire seal holes of the mat seal have a diameter, such that a wire received therein is fitted water tight. Since the electrical contact terminals attached to the wire are much larger than the diameter of the wire and the corresponding diameter of the seal holes, it is not possible to insert the contact terminals through the mat seal. Instead, the wires have to be inserted through the seal holes of the mat seal in a first step and only after that the wires are crimped to the respective contact terminals. This kind of connector assembly is relatively complex.

[0005] One problem with the known waterproof connector assemblies using mat seals is that it is not possible to use the most common contact terminals therewith, but instead require a special kind of contact terminal which does not have any protruding latching tongues and which have rounded, smooth terminal edges that come into contact with the mat seal during insertion or extraction of the terminal. These special terminals are called "clean body" terminals. However, electrical contact terminals without latching tongues have several disadvantages. For one, the pull-out forces of standard terminals with latching tongues are higher and secondly, the connector housings are easier to manufacture. Further, the contact terminals with latching tongues commonly applied are standardized parts, and it is desirable to use such standardized parts also in connection with mat seals. In the past, even if it was possible to insert a contact terminal with latching tongues through the seal hole of a mat seal due to the orientation of the latching tongue, it was not possible to remove the contact terminal again through the mat seal, since in that case the free end of the latching tongue would block such a movement and probably damage and thus destroy the mat seal.

[0006] In view of the above, it is an object of the present invention to provide an electrical connector assembly comprising a block or mat seal, which overcomes the above problems. It is in particular an object of the present invention to provide an electrical connector assembly, which allows the use of standard contact terminals having latching tongues in connection with a mat seal, whereby the contact terminals cannot only be installed in the housing through the mat seal but can also be removed again through the mat seal without destroying it. These and other objects which will become apparent on reading the following description are solved by an electrical connector assembly according to claim 1.

Summary of the invention

[0007] According to the invention, an electrical connector assembly is provided comprising a housing with a plurality of cavities for the reception of electrical contact terminals. The assembly is further provided with a block or mat seal with a plurality of juxtaposed seal holes formed therethrough. The seal holes are adjacent to and aligned with at least some of the cavities of the housing similar to the design of the above mentioned WO 2013/031088. Thus, the assembly is constructed such that electrical contact terminals, with the corresponding wires or cables attached thereto, can be inserted through the seal holes into said cavities, where they can be fixed in a suitable manner, generally known to the skilled person. Preferably, the contact terminals comprise protruding latching tongues, which are adapted to latch onto corresponding portions inside of the housing, so that the contact terminals automatically latch in the correct position when fully inserted into the housing through the mat seal.

[0008] To allow a removal or disassembly of the contact terminals from the housing through the seal holes of the mat seal, the cavities of the connector housing comprise a portion, which is suitably inclined inwardly towards the mat seal. In other words, this inclination narrows the free diameter of the cavity in the direction towards the mat seal. This inclination or narrowing of the cavity is arranged such that the protruding latching tongues of inserted contact terminals will be engaged by said inclined portion and deflected, when the terminals are moved through the cavities. In particular upon removal of the contact terminals from the housing, the contact terminals are pulled through the cavities, whereby the latching tongues are deflected and pressed towards the terminal surface, so that they protrude less from the terminal surface and are most preferably essentially flush with the terminal surface. Thereby, due to this deflection of the latching tongue or tongues, the free end thereof is guided into the respective seal hole upon removal of the contact terminal from the housing, so that it is possible to fully remove the terminals from the housing through the mat seal, without the latching tongue interfering with that removal.

[0009] The portion of the cavity that is inclined can be a separate member fixed or inserted into the cavity, but it is preferably a part of an inner wall of the cavity, which is inclined inwardly towards the mat seal. Thus, if the cavity has for example an essentially rectangular cross-section for the reception of the contact terminal, the inclined portion is arranged such on one of the inner walls of the cavity, that it can interact with a corresponding protruding latching tongue.

[0010] Generally preferred, the seal holes of the mat seal comprise a funnel shaped entrance on at least one end, and preferably at the end adjacent to the cavities. The funnel shape facilitates the removal of the contact terminals through the seal holes of the mat seal. As mentioned above, the present invention is in particular suitable for applications in connector systems with large number of contacts, as it is in particular often the case with automotive applications, where connector systems are commonly used with 40, 60 or even 80 signal contacts.

[0011] It has been shown, that the inclination inside of the cavity should be in the range of an angle of between 3 and 30°, preferably at least 7°, more preferably at least 10° and most preferably at least 15°. Thus, if the inclination extends in the longitudinal direction or extension of the terminals, it is inclined with respect to the longitudinal axis of the terminals by most preferably approximately 15°.

[0012] In a preferred embodiment, the respective entrance of the cavities adjacent the mat seal is also funnel shaped. This facilitates the insertion of the contact terminals through the seal holes of the mat seal into the cavities of the housing. Generally preferred, the housing and the cavities are formed such that upon full insertion of the terminals, the electrical cables or wires crimped to

the terminals are arranged inside the mat seal holes and the latching tongues are latched onto corresponding latching portions of the housing, to fix the terminals inside the housing. Thus, the mat seal seals around the outer circumference of the electrical cables or wires and not around the metallic contact terminals themselves. This offers improved safety and sealing function.

[0013] Apparently, the skilled person will recognize, that the present invention is not limited to contact terminal embodiments with a single latching tongue, but also encompasses embodiments with more than one latching tongue, as in particular embodiments having two latching tongues on opposite sides of the terminals, which are likewise common standard terminals in the art.

Description of preferred embodiments

[0014] In the following, the invention is described exemplarily with reference to the enclosed figures, in which:

Fig. 1 shows an electrical connector assembly in an exploded view;

Fig. 2 is a three dimensional illustration of a "clean body" contact terminal;

Fig. 3 is a three dimensional illustration of a contact terminal comprising a latching tongue and rounded edges;

Fig. 4 shows in a schematic cut side view a contact terminal upon extraction from a seal hole of a mat seal;

Figs. 5 and 6 show schematic cut side views of a contact terminal fully inserted into a corresponding cavity of a connector housing;

Fig. 7 shows in a schematic cut view of a detail of an inventive cavity; and

Fig. 8 shows a schematic cut side view of an inventive cavity and a contact terminal arranged therein.

[0015] Fig. 1 shows a connector assembly 10 in a schematic exploded view. In the shown embodiment, the connector assembly comprises a housing 20 made up of a main part and a housing module 25, which is a part of housing 20. Further, a wire shroud 12 is shown as well as a mate assist lever 11, which serves to facilitate the mating process between housing 20 and a corresponding counter connector 30. The principle of such mate assist mechanisms is in general well known to the skilled person, so that it is refrained herein from giving a more detailed explanation thereof. Inside of housing 20, a number of cavities 50 are formed. These cavities are in assembled condition adjacent to a mat seal 22, which comprises a plurality of seal holes being juxtaposed and formed

through the mat seal 22. The mat seal 22 is held in its position by a mat seal retainer 23. The assembly 10 further comprises a connector seal 24 and a secondary lock 26, to fix the different components together. For the purposes of this description, also counter connector 30 is assumed to be part of connector assembly 10.

[0016] Fig. 2 shows in a schematic three dimensional illustration a typical contact terminal 35 of the "clean body" type, i.e. a contact terminal without any protruding latching tongues or latching lances but with rounded edges contacting the mat seal. The terminal 35 comprises a number of crimping wings 36, that can be bent or crimped around a corresponding electrical cable or wire (not shown). As one can derive from Fig. 2, the contact terminal, when crimped to a wire, does not comprise any protruding parts and can therefore be inserted through the seal holes of a typical mat seal without getting stuck or without damaging the seal. However, such "clean body" contact terminals are often undesirable, since e.g. the pull out forces of such terminals are relatively low. Therefore, in the art, contact terminals 40 are usually more desirable.

[0017] Fig. 3 shows a contact terminal 40 in a three dimensional schematic view. The contact terminal 40 exemplarily shown is a female terminal comprising a latching tongue 42, the function of which is generally known to the skilled person. At one end of terminal 40, wire crimping wings 47 are arranged as well as insulating crimping wings 46. Due to the arrangement of the latching tongue 42, it is easily possible to insert such a contact terminal through the seal holes of a mat seal; however, once inserted therethrough, the orientation of the latching tongue 42 will prevent that the terminal can be removed again through the seal hole. This is indicated in the cut side view of Fig. 4.

[0018] Here, one can see how the contact terminal 40 is partially inserted through the mat seal 22, respectively through a seal hole 29 provided therein. The latching tongue 42 will be deflected downwardly upon insertion from the right to the left in Fig. 4, and spring upward again as shown in Fig. 4, once the latching tongue 42 has cleared the exit of seal hole 29. As one can take from Fig. 4, in the position shown, it is no longer possible to remove contact terminal 40 out of the mat seal 22, i.e. to move it from the left to the right in Fig. 4. The latching tongue 42 would block any such movement and will damage or destroy mat seal 22, if one tries to pull the contact terminal 40 by force through the seal hole 29. It is further pointed out, that mat seal 22 comprises a funnel shaped entrance, the function of which will be explained further down below.

[0019] Fig. 5 and 6 show cut side views of the contact terminal 40 fully inserted into a corresponding cavity 50 of housing 20. As one can see, the contact terminal 40 is completely arranged outside of mat seal 22, and seal hole 29 fits around cable or wire 41, thereby providing the desired sealing function. The latching tongue 42 is latched onto a corresponding latching portion 28 of hous-

ing 20 to fix the terminal inside the housing. As the skilled person will recognize, in the latched condition, it is not possible to pull contact terminal 40 out through the seal hole 29, i.e. to the right in Figs. 5 and 6. For disassembly, respectively removal of contact terminal 40 from housing 20 respectively the cavity 50, a suitable release tool 48 is necessary, with which it is possible to deflect latching tongue 42 downwardly, such that it is no longer latched onto latching portion 28. Once the latching tongue 42 is deflected sufficiently downwardly, i.e. towards the body of contact terminal 40, it is possible to pull the contact terminal 40 out of cavity 50 through the seal hole 29 of mat seal 22, by pulling for example wire 41 to the right in the figures.

[0020] In the art, the latching tongue 42 would not easily fit through seal hole 29, since the same has to fit snugly around wire 41 to provide the desired sealing function. Due to the orientation of latching tongue 42, as shown in Fig. 4, the same will prevent that contact terminal 40 is removed from cavity 50. However, due to the inventive provision of a portion, which is inclined inwardly towards the mat seal, it is possible to engage and deflect the protruding latching tongue of terminal 40, upon movement of the terminal through said cavity 50. The inclined portion has the reference number 51. The skilled person will recognize, that contact terminal 40 can be moved to the right in Figs. 5 and 6 through cavity 50, until latching tongue 42 comes into contact with inclined portion 51. Then, upon further movement to the right, the inclined portion will deflect latching tongue 42 downward, until it is almost flush with the upper surface of contact terminal 40 and can thus easily be pulled through the narrow seal hole 29.

[0021] This process is shown in more detail in Fig. 8 in connection with Fig. 7. Fig. 7 shows a schematic three dimensional cut view of a detail of cavity 50. As one can see, the inclined portion 51 is in this embodiment shown on the bottom wall of cavity 50, respectively, the illustration of Fig. 7 is upside down compared to the illustrations of Figs. 5 and 6. Obviously, since the connector assemblies can be used and are used in any spatial orientation, the expressions up, down, right and left as used herein are only used in relation to the drawings, to facilitate the description of the shown elements of the connector assembly. From Fig. 7 one can see that the inclined portion makes up only a part of the lowermost wall of cavity 50. Since the latching tongue 42 is relatively small compared to the whole width of contact terminal 40, such a narrow inclined portion 51 is completely sufficient for the desired purpose. From the illustration of Figs. 7 one can further see the funnel shaped entrance 27 of seal hole 29.

[0022] In Fig. 8, one can see how latching tongue 42 is depressed downwardly by means of the inclination in inclined portion 51. Due to the funnel shaped entrance 27 of seal hole 29, it is now possible to pull the contact terminal 40 completely out of cavity 50 and out of connector housing 20 without damaging the mat seal 22.

Claims

1. Electrical connector assembly (10), comprising:

a housing (20) comprising a plurality of cavities (50) for the reception of electrical contact terminals (40);

a mat seal (22) having a plurality of juxtaposed seal holes (29) formed therethrough; which seal holes (29) are adjacent to and aligned with at least some of said cavities (50) of the housing, **characterized in that** the assembly (10) further comprises a plurality of contact terminals (40), the contact terminals comprising protruding latching tongues (42) adapted to latch onto a corresponding portion (28) of said housing; wherein the housing (20) is adapted such that the terminals (40) can be mounted through the seal holes (29) into said cavities (50);

wherein said cavities (50) comprise a portion (51) which is inclined inwardly, to engage and deflect the protruding latching tongues (42) of the terminals upon movement of the terminals through the cavities.

2. Electrical connector assembly according to claim 1, **characterized in that** said deflection of the latching tongue (42) is such that the free end thereof is guided into the respective seal hole (29), so that it is possible to remove the terminals (40) from the housing (20) through said mat seal (22).

3. Electrical connector assembly according to claims 1 or 2, **characterized in that** said portion is a separate member.

4. Electrical connector assembly according to claims 1 or 2, **characterized in that** the cavities (50) have an essentially rectangular cross-section and said portion (51) is a part of one inner wall of said cavities (50) which is inclined inwardly towards the mat seal (22).

5. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the seal holes (29) comprises a funnel shaped entrance (27) on at least one end, preferably the end adjacent the cavities (50).

6. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the mat seal (22) comprises at least eight seal holes (29) and the housing (20) comprises at least eight cavities (50) aligned with said holes.

7. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the inclination extends in longitudinal extension of the

terminals and is inclined at an angle of between 3 and 30°, preferably at least 7°, more preferably at least 10° and most preferably approximately 15°.

8. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the respective entrance of the cavities (50) adjacent the mat seal (22) is funnel shaped.

9. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the housing (20) and the cavities (50) are formed such that upon full insertion of the terminals (40), the electrical cables (41) of said terminals are arranged inside the mat seal holes (29) and the latching tongues (42) are latched onto corresponding latching portions (28) of the housing (20) to fix the terminals inside the housing.

10. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the terminals comprise each two latching tongues and the cavities comprise each two corresponding inclined portions.

11. Electrical connector assembly according to any one of the preceding claims, **characterized in that** the inclination narrows the free diameter of the cavity in the direction towards the mat seal.

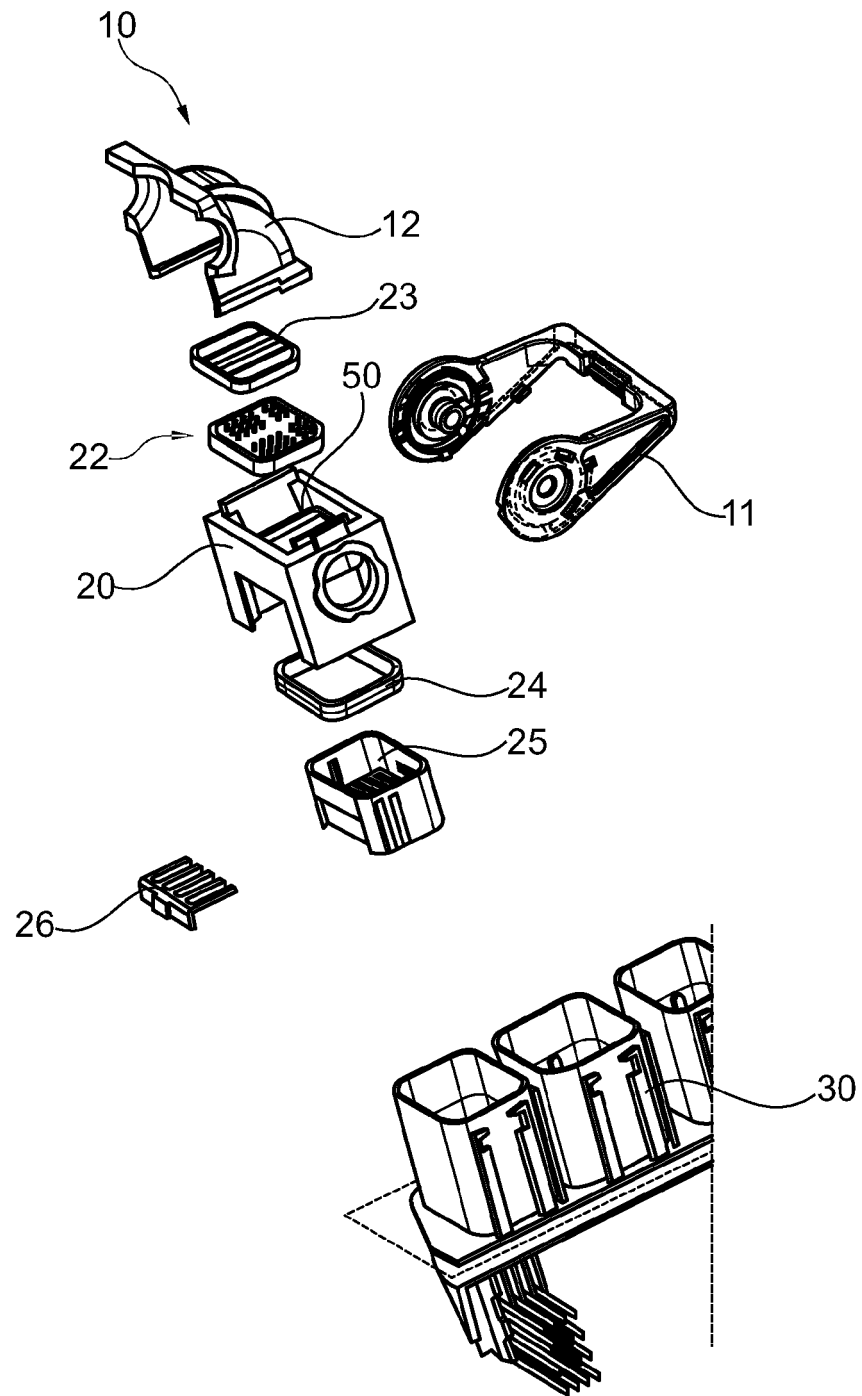


Fig. 1

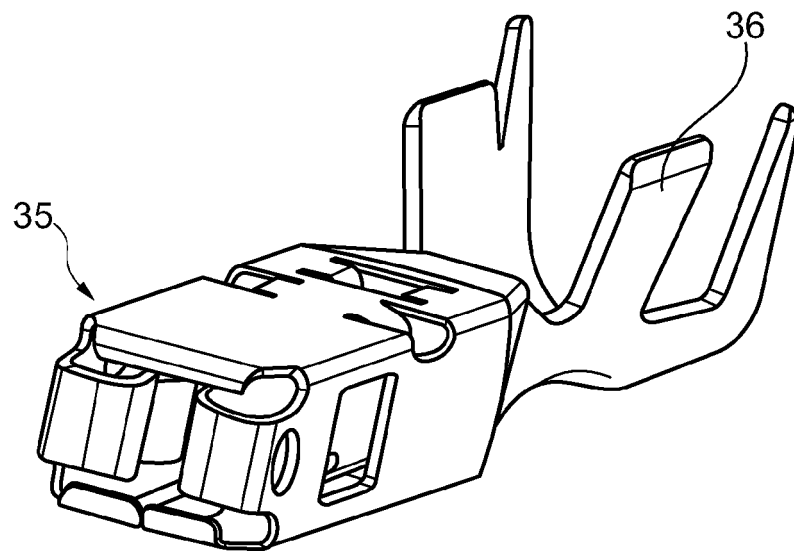


Fig. 2

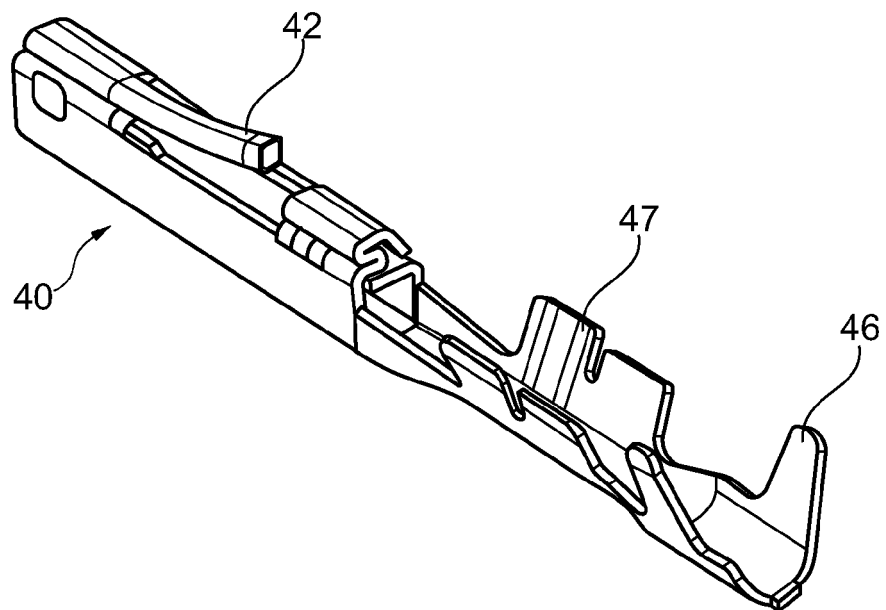


Fig. 3

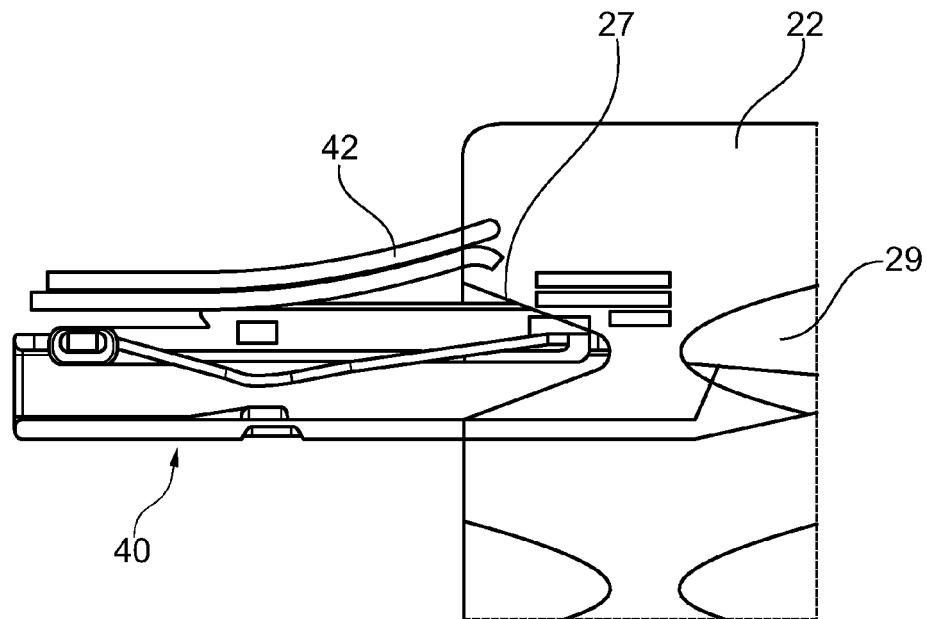


Fig. 4

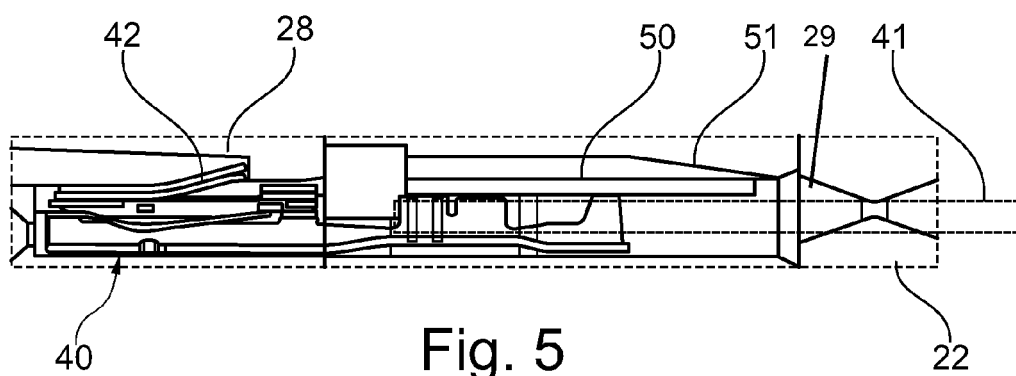


Fig. 5

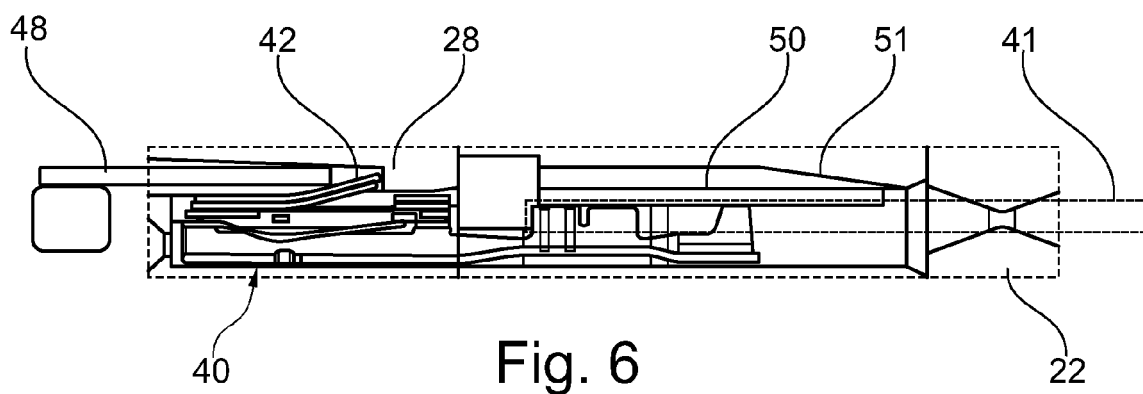


Fig. 6

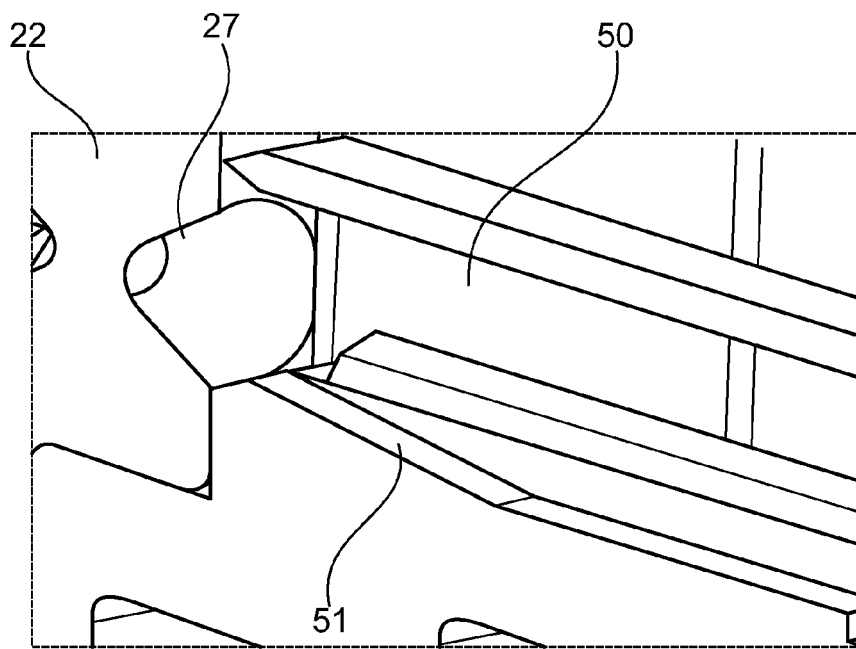


Fig. 7

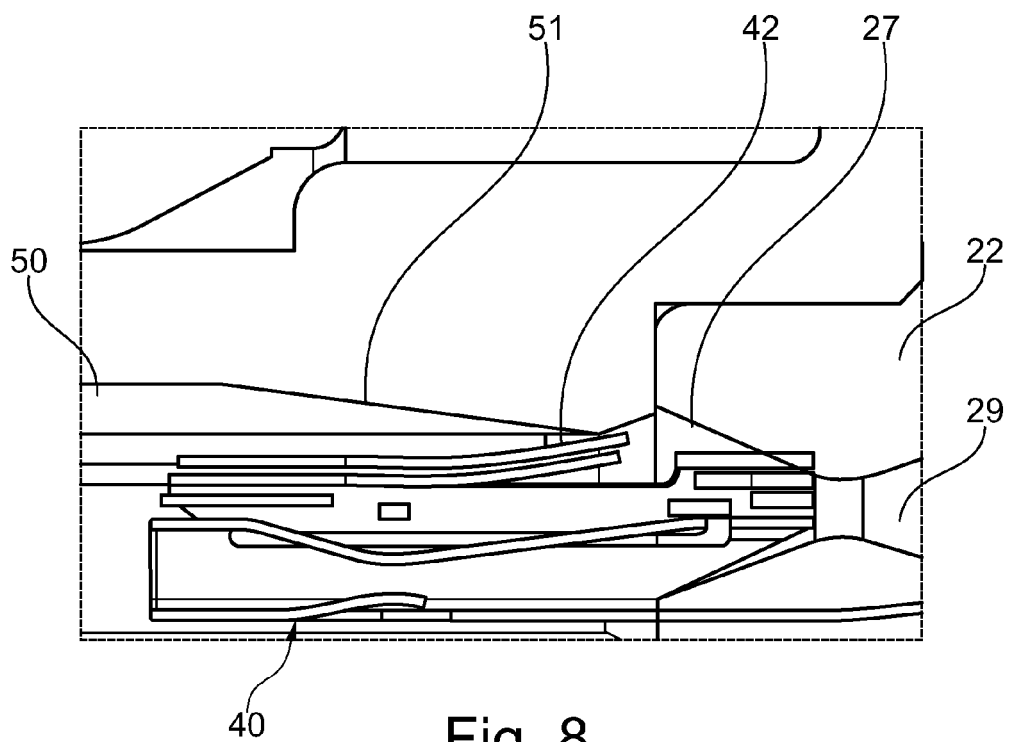


Fig. 8



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Application Number
EP 13 17 6417

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 December 2013	Examiner Bouhana, Emmanuel
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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