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(72) Inventors:  
 • **PLANAS GIRONA, ALBERT**  
**08232 VILADECAVALLS (ES)**  
 • **CARRILLO GALVEZ, CARLOS**  
**08232 VILADECAVALLS (ES)**

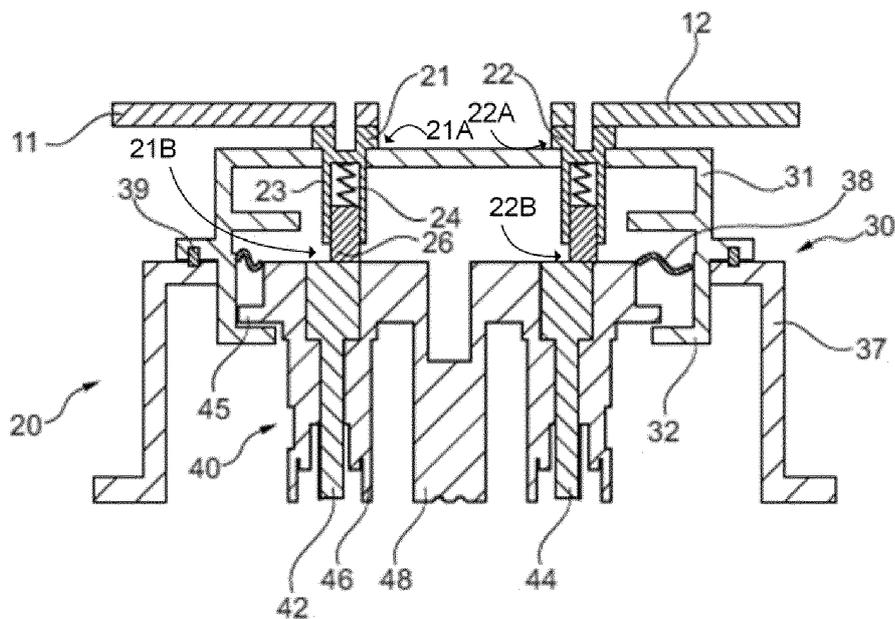
(71) Applicant: **Fico Triad, S.A.**  
**08028 Barcelona (ES)**

(74) Representative: **de Rooij, Mathieu Julien**  
**Bardehle Pagenberg S.L.**  
**Avenida Diagonal 420, 1° 1a**  
**08037 Barcelona (ES)**

(54) **ELECTRICAL CONNECTORS**

(57) Electrical connectors for electrically connecting a mating connector to a first and a second transmission line are disclosed. The connectors comprise a housing carrying a first terminal, and a second terminal, one or more contact carriers comprising a first contact and a second contact housing, the first and second contacts being electrically connected to the first and second terminals respectively. One or both of the first and second

contacts are floating contacts, wherein the floating contacts are substantially movable along the transverse axis with respect to the housing, and wherein the inner end of the floating contacts and the second end of the corresponding terminal are configured such that a movement of the floating contacts is allowed while maintaining an electrical connection between the floating contacts and the corresponding terminal.



**Fig. 1A**

**Description**

**[0001]** The present disclosure relates to electrical connectors, and more particularly relates to electric connectors in relatively rigid mountings or connections. The present disclosure particularly relates to electrical connectors for automotive vehicles.

**BACKGROUND**

**[0002]** Electrical connections generally comprise mating electrical connectors. One connector may be a male connector and may include pins or a plug configured to mate with another (female) connector having sockets, openings or recesses for receiving the pins. Inside such female coupling features, a corresponding pin may be arranged for the electrical contact.

**[0003]** The two parts of an electrical connection are manufactured separately and may be manufactured with different materials, and manufacturing technologies. The male and female electrical connectors may be manufactured by different entities and may be manufactured with different manufacturing tolerances. These manufacturing tolerances may affect the mating of the connectors both in an axial direction, and in a transverse plane perpendicular to the axial direction. The axial direction may herein be regarded as the direction of mating of the plug and socket coupling.

**[0004]** Electrical connections may be made between a power source (e.g. an electrical grid, a battery or other) and a component. Electrical connectors may sometimes be mounted with some flexibility, e.g. they may be attached to wiring or a flexible cable. In this case, connecting an electrical connector may be relatively easily done. Even a misalignment between the two electrical connectors, which may be caused by manufacturing tolerances can be compensated by one of the connectors or both of the connectors displacing.

**[0005]** The present disclosure however relates to electrical connectors which may be rigidly mounted in place and which may be connected to rigid or semi-rigid transmission lines, e.g. an electrical coupling to a battery, a relatively thick electrical cable or rigid busbars.

**[0006]** In one example, such busbars may be connected e.g. to a battery of a vehicle such as a car. With such a rigid system, a misalignment between male and female subassemblies cannot readily be compensated. And it may thus be found that mating the electrical connector of a component (male or female) with an electrical connector (female or male) of the electrical circuit can be complicated.

**[0007]** The present disclosure in various examples provides electrical connectors of an electrical connection and electrical connections which allow suitable mating of the electrical connectors even in case of inaccuracies or high tolerances in manufacturing of the separate connectors, and even in case of rigid mountings or connections of the connectors.

**SUMMARY**

**[0008]** In a first aspect, an electrical connector for electrically connecting a mating connector to a first and a second transmission line is provided. The electrical connector comprises a housing carrying a first terminal having a first end for contacting the first transmission line, and a second terminal having a first end for contacting the second transmission line, and one or more contact carriers comprising a first contact and a second contact, the first and second contacts having an inner end electrically connected to a second end of the first and second terminals respectively, and having an outer end for electrically connecting with corresponding contacts of the mating connector. An axial direction is defined as a direction of mating of the electrical connector with the mating connector, and a transverse axis is defined as an axis that is perpendicular to the axial direction. One or both of the first and second contacts are floating contacts, wherein the floating contacts are substantially movable along the transverse axis with respect to the housing, and wherein the inner end of the floating contacts and the second end of the corresponding terminal are configured such that a movement of the floating contacts is allowed while maintaining an electrical connection between the floating contacts and the corresponding terminal.

**[0009]** In accordance with this first aspect, an electrical connector is provided that can adapt for misalignment, and for some mismatch in dimensions between the electrical connector and the mating connector. The potential mismatch due to e.g. manufacturing tolerances may be compensated in a transverse direction (i.e. perpendicular to the direction of mating of the electrical connectors) by biasing members pushing the contacts away from the terminals. A user may attempt to mate the female coupling parts with the male coupling parts and since the contacts are movable in the transverse direction, they will displace as needed.

**[0010]** Along the transverse axis, or in a transverse plane, the electrical contact with the terminals can be ensured with suitable shaping and sizing of the inner ends of the contacts and the second ends of the terminals. Unlike some prior art systems, no components beyond the electrical connector need to be modified. E.g. standard busbars may be used.

**[0011]** Throughout the present disclosure, the term "transmission line" is to be understood as a cable or busbar or any other structure designed to conduct electricity. The terminals as used throughout the present disclosure may particularly relate to fixed terminals, i.e. terminals that cannot displace, or only have very limited movement. Such fixed terminals may be relatively rigidly mounted or fixedly mounted to other components.

**[0012]** In some examples, one or both of the first and second terminals may comprise a contact brush for electrically connecting with the inner end of the floating contacts. A contact brush may provide frictional contact al-

lowing relative displacement between terminals and contacts (or contact carriers).

**[0013]** In some examples, at least one of the first and second terminals may comprise one or more biasing members configured to urge the contact brush in contact with the inner end of the floating contacts. Optionally, the biasing members may comprise springs. Other elastic or resilient biasing members may also be used. The biasing members may ensure or improve contact between the contact brushes and the contacts. Moreover, in some cases they can allow for a potential mismatch (e.g. due to manufacturing tolerances) in the axial direction to be absorbed.

**[0014]** In some examples, a dimension of the inner ends of the first and second contacts along the transverse axis may be different from a dimension of the first and second terminals along the transverse axis. Along the transverse axis, or in the transverse plane the inner ends of the first and second contacts may have an increased diameter, or length and/or width with respect to the first and second terminals. Alternatively, the first and second terminals may be enlarged (e.g. have increased radius, diameter, length and/or width) with respect to the first and second contacts. In both cases, a relative displacement is allowable while maintaining electrical contact. In yet further examples, the contacts and terminals may be similarly sized, while allowing a transverse displacement without losing an electrical connection.

**[0015]** In some examples, the electrical connector may comprise a single contact carrier comprising the first and the second contact. With a single contact carrier, a distance between the two contacts may be fixed. In some other examples, the electrical connector may comprise a first contact carrier comprising the first contact and a second contact carrier comprising the second contact, and wherein the second contact carrier is movable along the transverse axis with respect to the first contact carrier. With separate contact carriers, a distance between the first and second contacts (e.g. pins) may be adapted, such that a potential mismatch in a distance between the contacts can be adapted for as well by moving one contact carrier with respect to the other.

**[0016]** In some examples, a flexible joint may be arranged between the first and the second contact carrier. Such a flexible joint may be flexible both in an axial direction and/or in a transverse direction.

**[0017]** In some examples, the electrical connector may comprise a gasket arranged between a sidewall of the housing and the contact carriers. The gasket may be resilient or flexible at least in the transverse plane. The gasket may allow for displacement in the transverse plane, while at the same time ensures appropriate sealing and can avoid e.g. dust, dirt or water to reach the terminals, or the electrical circuit behind the electrical connector in general.

**[0018]** In some examples, the contacts of the contact carriers may form plugs or pins for mating with sockets of the mating connector. Alternatively, the contact carriers

may comprise sockets (in which the contacts may be arranged) for mating with plugs of the mating connector.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

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10 Figures 1A - 1C schematically illustrate an example of an electrical connector;

15 Figures 2A - 2D schematically illustrate a further examples of an electrical connector engaging with a mating connector;

20 Figure 3 schematically illustrates yet a further example of an electrical connector;

25 Figures 4A and 4B respectively schematically illustrate an isometric exploded view and a cross-sectional view of a further example of an electrical connector and a mating connector; and

30 Figures 5A and 5B respectively schematically illustrate an isometric exploded view and a cross-sectional view of yet a further example of an electrical connector and a mating connector.

## 35 DETAILED DESCRIPTION OF EXAMPLES

**[0020]** Figures 1A - 1C schematically illustrate an example of an electrical connector 20. The electrical connector 20 may be arranged in a vehicle, e.g. a car and may provide an electrical connection between a power source e.g. a car battery and an electrical system in the car. The car may be a hybrid or an electric vehicle. The electrical systems may be or include particularly an electric engine, but in other examples may include auxiliary systems such illumination, cameras and many others.

**[0021]** In a specific example, the electrical connector may be provided for high power DC transmission. High power may herein be regarded as having a current higher than 100A e.g. more than 200A or 300A.

**[0022]** The electrical connector 20 is arranged for electrically connecting a mating connector (not shown) to a first transmission line i.e. first busbar 11 and a second transmission line i.e. second busbar 12. The first busbar 11 may be connected to a positive electrode of a car battery, and the second busbar 12 may be connected to a negative electrode of a car battery.

**[0023]** The electrical connector 20 includes a housing 30 carrying a first terminal 21 having a first end 21A for contacting the first busbar 11, and a second terminal 22 having a first end 22A for contacting the second busbar 12. The electrical connector 20 further comprises one or more contact carriers 40 comprising a first contact 42 and a second contact 44.

**[0024]** The first and second contacts 42, 44 have an inner end 42A, 44A electrically connected to the second ends 21B, 22B of the first and second terminals 21, 22 respectively, and having an outer end 42B, 44B for electrically connecting with corresponding contacts of the mating connector (not shown).

**[0025]** One or both of the first and second contacts may be "floating" contacts, i.e. they may be movably arranged within the housing 30. In this particular case, the single contact carrier 20 is movably arranged and the contact carrier 20 carries both the first and second contacts 42, 44. Both the first and second contacts 42, 44 are therefore movably arranged, but they move in unison.

**[0026]** The electrical connection between the first and second contacts 42, 44 with their respective terminals 21, 22 may comprise a first and second contact brushes 26 that are in contact with the inner end of their respective contact 42, 44. A contact brush 26 may be made from e.g. carbon or copper.

**[0027]** Biasing members 24 configured to urge the contact brushes 26 to their respective contacts 42, 44 may be provided for assuring the electrical connection between them. The biasing members can increase and/or ensure the frictional contact between contact brushes 26 and contacts 42, 44. Furthermore, the biasing members 24 urging the contact brush towards the contacts may also absorb some linear misalignments in an axial direction. The contact carrier 40 is substantially movable along a transverse axis with respect to the housing 30. A dimension of the inner ends 42A of the first and second contacts 42, 44 along the transverse axis may be larger than a dimension of the first and second contact brushes 26 along the transverse axis. In this particular case, the diameter of the inner ends 42A, 44A of the first and second contacts 42, 44 is larger than a diameter of the contact brushes 26.

**[0028]** In the particular example of figure 1, the electrical connector 20 comprises a single contact carrier 20 comprising and carrying both the first 42 and the second contact 44. It will be illustrated however in other example, that the contact carrier may be split in parts. Or, in other words, that the electrical connector may comprise more than one contact carrier 40.

**[0029]** In the particular example of figure 1, the housing 30 comprises a first housing (or "terminal housing") 31 and a second (or "contact housing") 37. The first housing forms the physical structure in which or to which the terminals and transmission lines are attached. The second housing forms the physical structure in which the mating of the electrical connectors take place.

**[0030]** In other examples, a single integrally formed housing may be used. The housing(s) may be made from suitable insulating material, such as e.g. a plastic. Injection moulding may be used in some examples for the manufacture of the housing. In this particular example, the housing comprises a retaining member to limit an axial separation between the contact carriers and the first and second terminals. The retaining member in this ex-

ample is a housing flange 32 configured to engage with a flange 45 of the contact carrier 40.

**[0031]** In this particular example, a gasket 38 is arranged between a sidewall of the housing 30 and the contact carrier 40. In this particular case, the gasket 38 is arranged between the contact carrier 40 and the first housing 31. In other examples, the gasket may instead be arranged in contact with the second housing 37.

**[0032]** The gasket 38 may be substantially cylindrical in the case of a cylindrical connector 20 and it may be resilient or have elasticity i.e. it may have some flexibility to deform and the ability to return to its original shape after a deformation. The resiliency or elasticity may come from the shape of the gasket and/or from the material of the gasket. A suitable material for the gasket may be an elastomer, such as e.g. a rubber, silicone or a thermoplastic elastomer.

**[0033]** The gasket 38 may provide sealing between the cavity where the connection between the contacts and its respective terminal is made and the environment. In this way, dirt, dust and water from the environment in which the electrical connector is placed is prevented from reaching said connection.

**[0034]** A further seal 39 may be provided in this example between first housing 31 and second housing 37. Any suitable seal may be used.

**[0035]** In this example, the biasing members may include springs 24. The springs 24 may be helicoidal springs. In other examples, other biasing members that provide a biasing force through e.g. elasticity or resiliency of a material of the biasing member on the contact carrier pushing it away from the busbars 11 and 12 may be used.

**[0036]** The first and second terminals 21, 22 in this example include a cylindrical holder 23 housing the spring 24 that pushes the brush 26 into contact with the first and second contacts 42, 44. An electrical contact in this example is established between first and second terminals 21, 22 through the brush 26 and the first and second contacts 42, 44. The contact may be established through sidewalls of the holder 23 to the brush 26 and/or through the biasing member 24 to the brush 26.

**[0037]** In alternative examples, the second ends 21B, 22B of the terminals and inner ends 42A, 44A of the contacts 42, 44 may be differently shaped and sized, while allowing a relative displacement without losing the electrical connection. For example, fixed bus contacts may be larger than the inner ends of the contacts. It should be clear that the cross-sectional shape of the contacts and terminals may vary, and may be e.g. circular, annular, rectangular, square or different.

**[0038]** The functioning of the electrical connector 20 may be illustrated with reference to figures 1B and 1C. Busbars 11 and 12 may be relatively rigid. The busbars 11 and 12 may be fixed to the terminals 21, 22. Suitable fasteners, such as screws or bolts may be used to fix the busbars 11, 12, terminals 21, 22 and housing 30 rigidly in place.

**[0039]** A mating connector (not shown in figure 1) may

not exactly mate with the connector 20. This may be due e.g. to manufacturing tolerances. In figure 1C, it may be seen how a variation in the transverse plane may be compensated. A neutral line 70 may indicate a theoretical centric position of the contact carrier 40 with respect to the housing 30. In the top figure, the contact carrier is displaced to the left with respect to the neutral line 70. In the bottom figure, the contact carrier 40 is displaced to the right with respect to the neutral line 70. In some examples, a variation of +/- 5 mm along a transverse axis may be compensated. In some examples, a variation of +/- 5 mm in the transverse plane may be compensated i.e. in any direction of the transverse plane.

**[0040]** It may also be seen in figure 1C how the dimensions of inner ends 42A, 44A of contacts 42, 44 in the transverse plane allow the brush 26 to maintain contact in spite of a displacement. In practice, a user may try to mate the connector 20 with another connector and thereby force contact carrier to a position in the transverse plane in which mating is possible. The resiliency of gasket 38 means that the contact carrier is movable in the transverse plane. The gasket may continue to provide sealing between contact carrier and an inside of a side wall of housing 30 in the various positions. The biasing members 24 additionally may push the brushes away from the terminals and force them to touch and connect with the contacts. When a user attempts to engage the connector with a mating connector, he/she will thereby push the contacts 42, 44 and/or contact carrier inwards against the force of the biasing members. The biasing members at all intermediate positions ensures contact between brush 26 and a inner end 42A, 44A of the contacts 42, 44.

**[0041]** The manufacturing tolerances may also cause a mismatch in the axial direction (z). I.e. the mating connector may, when mounted, reach closer or further away from the busbars 11, 12.

**[0042]** It may be seen in figure 1B how the electrical contact 42, 44 may be maintained for the different axial positions. In the figure on the left hand side, the biasing members 24 are more extended, i.e. a distance between the inner end 42A, 44A of the contacts 42, 44 is larger than in the situation on the right hand side of figure 1B (in which the biasing members 24 are more compressed). A neutral line 60 may indicate a theoretical position of the contact carrier in the absence of manufacturing tolerances. In some examples, a variation of +/- 5 mm with respect to the neutral line may be compensated.

**[0043]** Figures 2A - 2D schematically illustrate a further examples of an electrical connector 20 engaging with a mating connector 50. Figure 2A shows a cross-sectional and exploded view of the various part of the electrical connection. Figures 2B and 2C show connector 20 and mating connector 50 in different relative positions during mating. Figure 2D shows an isometric exploded view.

**[0044]** Similarly as in the example of figure 1, the electrical connector 20 of figure 2 may electrically connect a component (electrically connected to mating connector 50) to rigid busbars 11 and 12. Terminals 21, 22 are at-

tached to busbars 11 and 12 with a suitable fastener 15. The fastener 15 may clamp the terminals 21, 22 in fixed contact with busbars 11, 12 respectively. The terminals are thereby substantially fixed in place. The holder of the contact brush 26 may be a threaded bush, for mating with a suitably threaded fastener 15.

**[0045]** A spring 24 may be arranged inside a cylindrical holder in terminals 21, 22. The spring 24 may push against an inner side of a brush 26 which in turn can push against a inner end 42A, 44A of electrical contacts 42, 44. The electrical contact may be made from a suitable conducting material such as e.g. copper, or copper alloys or brass alloys. An insulating sleeve 46 may be arranged around contacts 42, 44. Contact 42, 44 with sleeve 46 may form a "plug" or male coupling element which can mate with a suitable female coupling element on mating connector 50. It should be clear however, that in other examples, the male and female features may be interchanged between the connector 20 and mating connector 50.

**[0046]** In this particular example, the electrical connector 20 may carry further mechanical protrusions or guiding pins 48 to ensure proper mating and fitting with connector 50. The guiding pins 48 may engage with a guiding socket on the mating connector and can increase stability during the connection process as the contact carrier 40 is relocated within the housing 30.

**[0047]** A difference between the example of figure 2 and the example of figure 1 is that the contact carrier 40 is integrally formed with the second housing or "contact housing". A sealing or gasket 38 comprises a central cylindrical portion and an annular portion surrounding the central cylindrical portion. The annular portion may be compressed radially and thereby provides the movable or floating arrangement of the contact carrier 40 in the transverse plane, as was already illustrated with reference to figure 1.

**[0048]** In this particular example, the gasket 38 may include flanges that engage with a rear surface of the housing 30. The gasket may thus be fitted about the housing 30 and snap in place and stay in place. In this particular example, the gasket 38 may include a retention feature to limit the axial separation of the contact carrier 40 and the first and second busbars 11, 12.

**[0049]** Similarly as in figure 1, the cross-sectional dimensions of the contacts 42, 44 at a inner end may be larger than the cross-sectional dimensions of the brush 26. This allows for a relative transverse displacement between the contacts 21, 22 and the housing 30 while maintaining contact.

**[0050]** Figure 3 schematically illustrates yet a further example of an electrical connector 20 rigidly mounted to busbars 11, 12. The electrical connector 20 of figure 3 is generally similar to the example of figure 1 and allows compensation in the transverse plane through elasticity or flexibility of the seal 38. Also, some compensation in the axial direction (z-axis) through biasing members 24 may be provided as before. However, the electrical con-

connector of this example comprises a first contact carrier 40A comprising the first contact 42 and a second contact carrier 40 B comprising the second contact 44, and wherein the second contact carrier 40B may be movable along the transverse axis with respect to the first contact carrier 40 A.

**[0051]** The electrical connector may further comprise a flexible joint 41 between the first and the second contact carriers 40A, 40B. The flexible joint 41 may allow relative movement along the transverse axis x, or generally in the transverse plane. Alternatively or additionally, the flexible joint 41 may allow axial relative movement, i.e. along the z-direction. Separate contact carriers 40A, 40B allow a displacement of the contacts 42 and 44 with respect to each other, such that a misalignment in this sense on the mating connector can also be compensated. A flexible joint can have the effect that one of the first and second contacts drags the other contact in the same direction as mating of electrical connectors take place.

**[0052]** In any of the examples, the contact carriers 40 may comprise plugs carrying the contacts (or the contacts may be the plugs) for mating with sockets of the mating connector. Alternatively, the contact carriers 40 may comprise sockets carrying the contacts for mating with plugs of the mating connector.

**[0053]** Figures 4A and 4B schematically illustrate yet a further example of an electrical connector 20 rigidly mounted to busbars 11, 12. The electrical connector 20 may form part of a vehicle power supply in this example. The electrical connector 50 is configured to mate with electrical connector and may thereby provide power to a mechatronic system of the vehicle.

**[0054]** The electrical connector 20 of figure 4 is generally similar to the example of figure 3 and allows compensation in the transverse plane through elasticity or flexibility of the seal or gasket 38 arranged between contact carrier 40 and housing 30. Also, some compensation in the axial direction (z-axis) through biasing members 24 may be provided as before. Housing 30 may be made from a suitable insulating material such as a plastic.

**[0055]** The electrical connector 20 of this example comprises a contact carrier 40 comprising first and second contacts 42, 44. In this particular case however, the first and second contacts 42, 44 are arranged in sockets 47 of the contact carrier. The sockets 47 may be formed as insulating sleeves, and the metallic contacts 42, 44 inside the sockets 47 make contact with pins 51 and 52 of the mating connector 50. The metallic contacts may be seen to extend through contact carrier 40 in order to make contact with first terminal 21 and a second terminal 22 (see also figure 4B). As before, a contact brush 26 is urged towards contacts 42, 44 by a spring 24 and electrical contact is established and can be maintained even with some transverse movement, and some axial movement.

**[0056]** The electrical connector 50 may comprise a plastic housing 55, and may provide electrical power towards a mechatronic system through buses 61, 62. Bus-

es 61, 62 may be connected to connector 50 through suitable fasteners 65.

**[0057]** A difference between the electrical connector 20 of figure 4 and e.g. the connector of figure 2 is further that no guiding pins and sockets or other guiding features for mating of the connectors are provided.

**[0058]** The example of figures 5A and 5B is comparable to the example of figure 4B. The electrical connector 20 of this example may mate with a connector 50 that is the same or very similar to the connector 50 of figure 4. The electrical connector 20 and mating connector 50 may also be used for similar purposes. As in figure 4, the electrical connector 20 has sockets 47 in single contact carrier 40. But the single contact carrier has first and second electrical contacts which are movably arranged within the contact carrier, and are thus also movable with respect to the housing.

**[0059]** The contact carrier 40 may be moved with respect to the housing to a gasket 38 which offers some flexibility or deformability. The contact carrier 40 comprises a flexible mounting element 49 which enables movements of the contacts in the transverse plane, also with respect to each other. The flexible mounting element 49 may derive its flexibility from its material (it may be made e.g. from a rubber, silicone, or elastomer), from its shape (due to e.g. folds) or both.

**[0060]** The flexible mounting element 49 may comprise a deformable part 49A and 49B surrounding the first and second contacts 42, 44 respectively. The flexible mounting element may also comprise a more rigid part 49C in an area between the first and second contacts. The rigid part may be more centrally arranged than the deformable parts 49A and 49B. An edge or rim portion 49A surrounding the contacts. Deformable and rigid herein are not to be understood as absolute terms, as the flexible mounting element may be made entirely from a relatively flexible material. Rather, it is meant that an area of the central portion 49B may be more readily deformable than another area. The deformable parts 49A and 49B may comprise e.g. folds, crests and troughs to allow for movement.

**[0061]** In between the first and second contacts 42, 44, a central rib 43 of the contact carrier may be arranged. The flexible mounting element 49 may allow movement of the first and second contact 42, 44 with respect to the stiffer central rib 43 and surrounding walls of the contact carrier 40.

**[0062]** In some alternative examples, the gasket 48 may be relatively rigid. I.e. in such an example, the contact carrier as a whole has less or no movement possibility. The flexible mounting element 49 may still allow for one or both contacts to displace as needed for mating.

**[0063]** Even though in the illustrated examples, a direct current (DC) coupling was shown, in other examples, an alternating current (AC) coupling may be used. Even though in the illustrated examples, only a first and second contact carried by the contact carrier(s) are shown, it should be clear that the contact carrier may carry addi-

tional contacts (e.g. an earthing pin). In yet further examples, an electrical connector might include more electrical connections to more than two transmission lines.

**[0064]** In further non-illustrated examples, the electrical connector 20 may include further or different features for mating with another connector. Such features may be structural features i.e. non-electrical connections.

**[0065]** Although in the illustrated examples, contacts 42, 44 of a substantially cylindrical form, i.e. contacts that are substantially circular in cross-section, were shown, it should be clear that other forms may be chosen as well. Similarly, depending on the shape of the connector 20, different and multiple gaskets 38 or seals may be incorporated.

**[0066]** Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the claims that follow.

## Claims

1. An electrical connector for electrically connecting a mating connector to a first and a second transmission line comprising:

a housing carrying a first terminal having a first end for contacting the first transmission line, and a second terminal having a first end for contacting the second transmission line, one or more contact carriers comprising a first contact and a second contact, and the first and second contacts having an inner end electrically connected to a second end of the first and second terminals respectively, and having an outer end for electrically connecting with corresponding contacts of the mating connector, wherein an axial direction is defined as a direction of mating of the electrical connector with the mating connector, and a transverse axis is defined as an axis that is perpendicular to the axial direction, wherein one or both of the first and second contacts are floating contacts, wherein the floating contacts are substantially movable along the transverse axis with respect to the housing, and wherein the inner end of the floating contacts and the second end of the corresponding terminal are configured such that a movement of the floating contacts is allowed while maintaining an electrical connection between the floating contacts and the corresponding terminal.

2. The electrical connector according to claim 1, wherein one or both of the first and second terminals comprise a contact brush for electrically connecting with the inner end of the floating contacts.
3. The electrical connector according to claim 2, wherein at least one of the first and second terminals comprises one or more biasing members configured to urge the contact brush in contact with the inner end of the floating contacts.
4. The electrical connector according to claim 3, wherein the biasing members comprise a spring.
5. The electrical connector according to claim 3 or 4, wherein the contact carriers are movably mounted within the housing and the biasing members force the contact carriers away from the first and second terminals, and comprising a retaining member to limit an axial separation between the contact carriers and the first and second terminals.
6. The electrical connector according to claim 5, wherein the retaining member comprises a housing flange configured to engage with a flange of the contact carriers.
7. The electrical connector according to any of claims 1 - 6, wherein a dimension of the inner ends of the first and second contacts along the transverse axis is different from a dimension of the first and second contact brush along the transverse axis.
8. The electrical connector according to any of claims 1 - 7, wherein a transverse plane is defined as a plane perpendicular to the axial direction, and wherein the floating contacts are movable along the transverse plane.
9. The electrical connector according to any of claims 1 - 8, comprising a single contact carrier comprising the first and the second contact.
10. The electrical connector according to any of claims 1 - 8, comprising a first contact carrier comprising the first contact and a second contact carrier comprising the second contact, and wherein the second contact carrier is movable along the transverse axis with respect to the first contact carrier.
11. The electrical connector according to claim 10, further comprising a flexible joint between the first and the second contact carrier.
12. The electrical connector according to any of claims 1 - 11, further comprising a gasket arranged between a sidewall of the housing and the contact carriers.

13. The electrical connector of claim 12, wherein the gasket is made from an elastomer.
14. The electrical connector of any of claims 1 - 1, wherein the first and second contacts are plugs for mating with sockets of the mating connector. 5
15. The electrical connector of any of claims 1 - 1, wherein the first and second contacts are arranged at least partially in sockets for mating with plugs of the mating connector. 10

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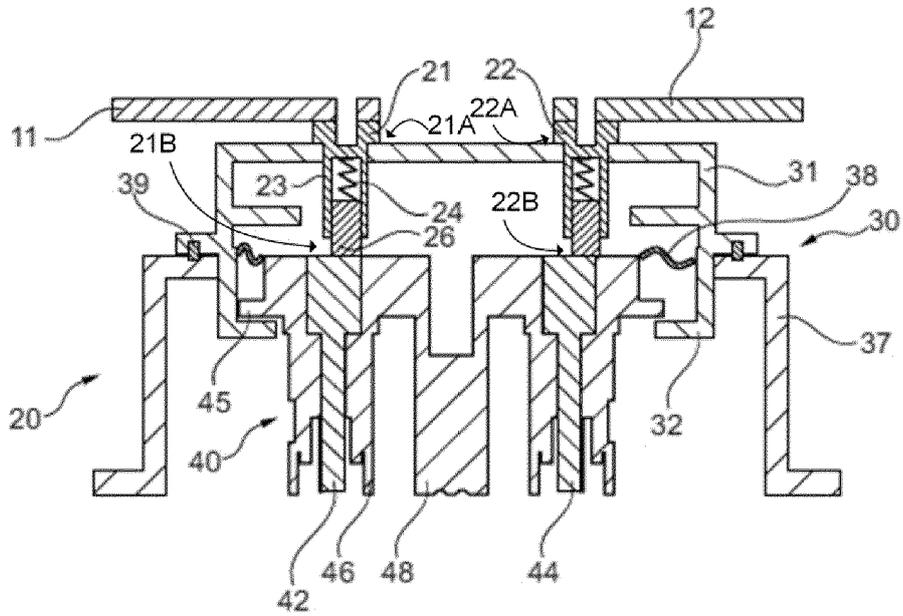


Fig. 1A

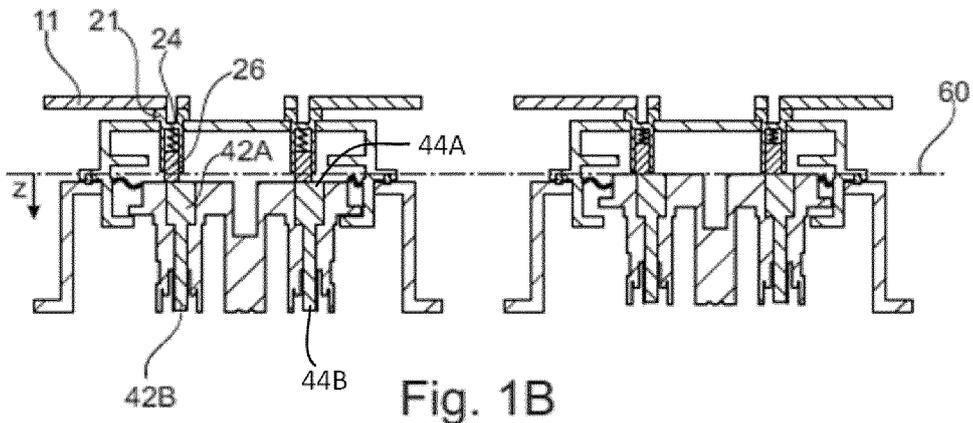


Fig. 1B

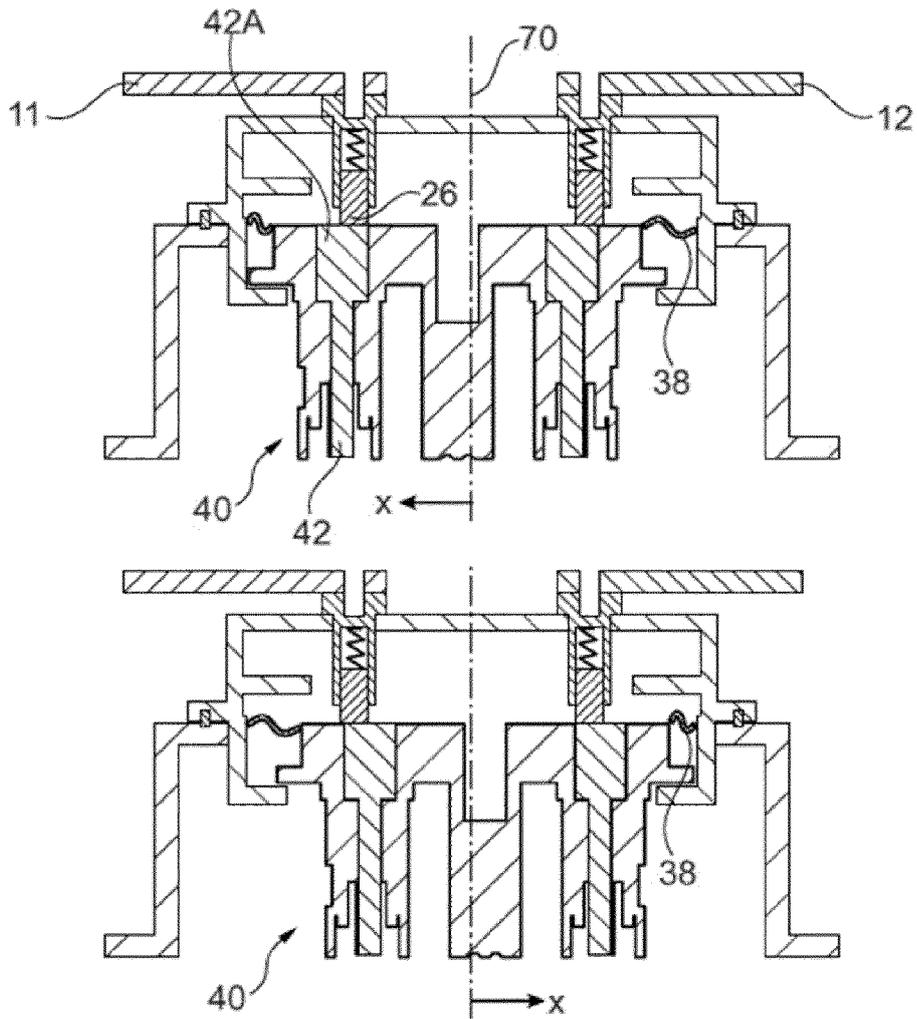


Fig. 1C

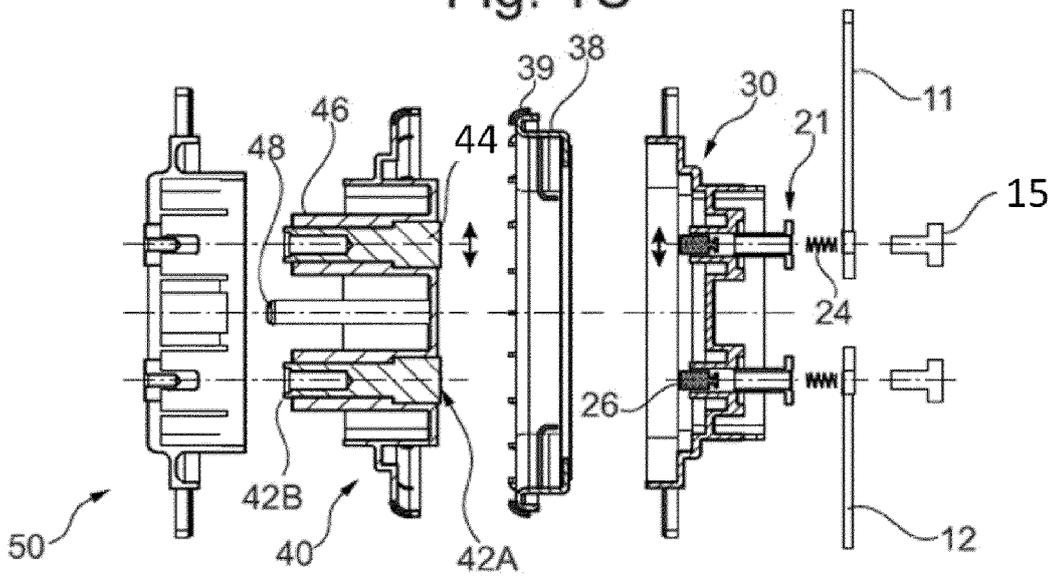


Fig. 2A

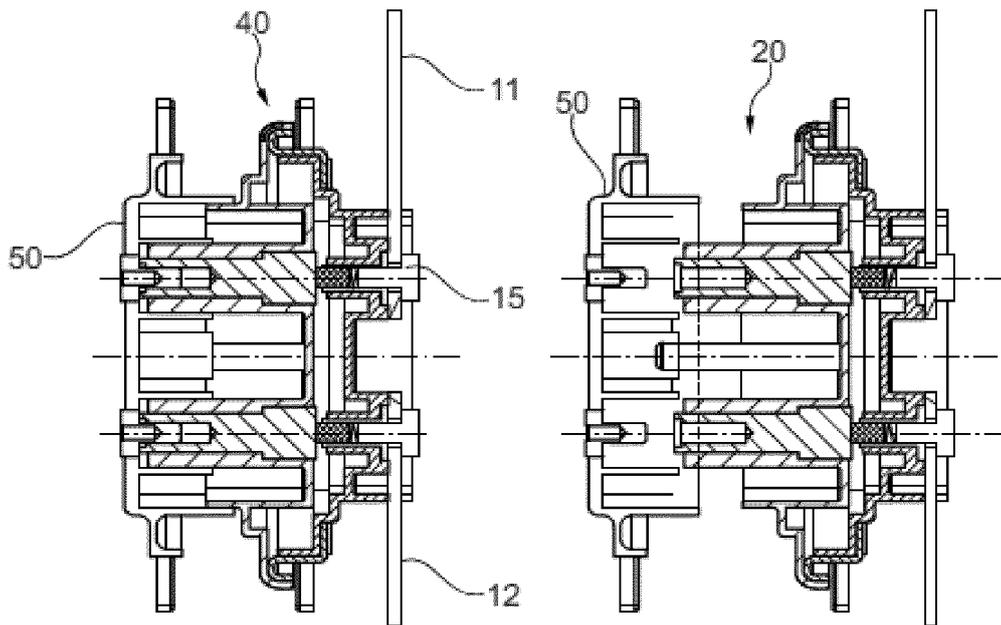


Fig. 2B

Fig. 2C

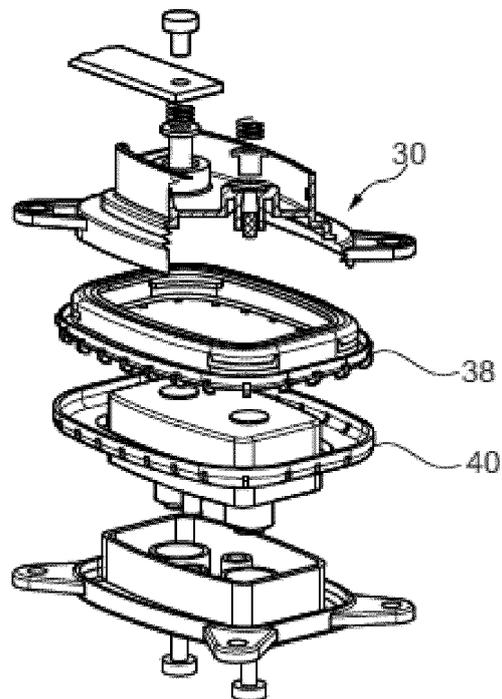


Fig. 2D

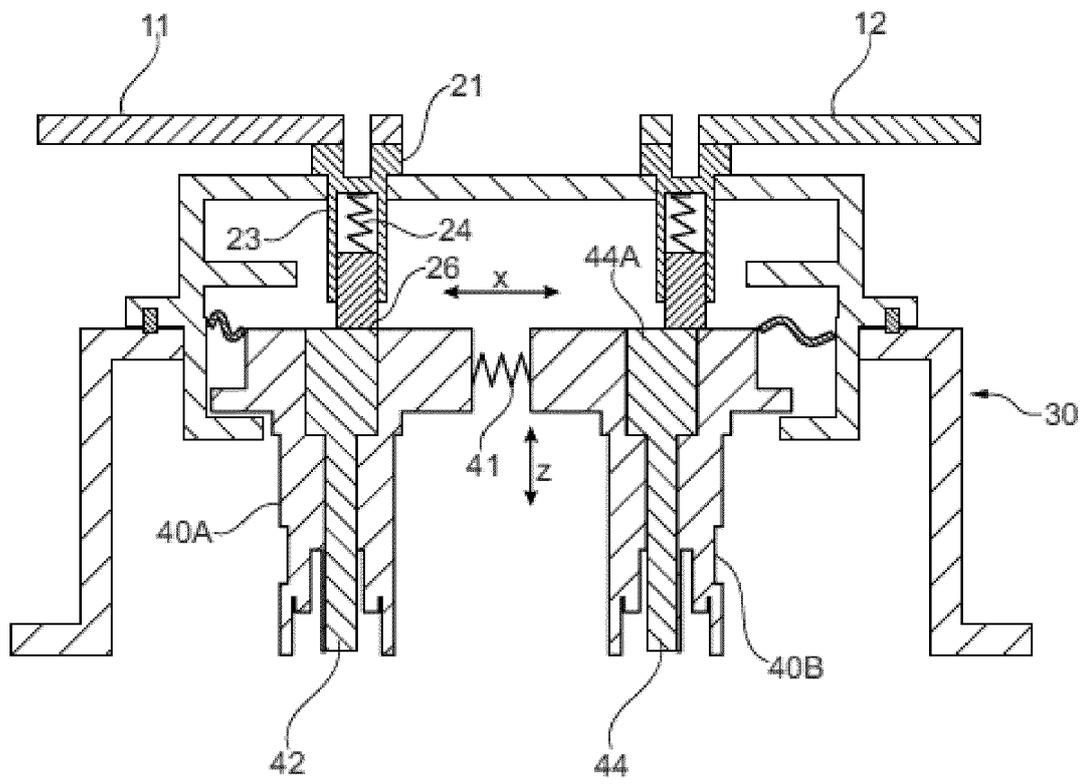


Fig. 3

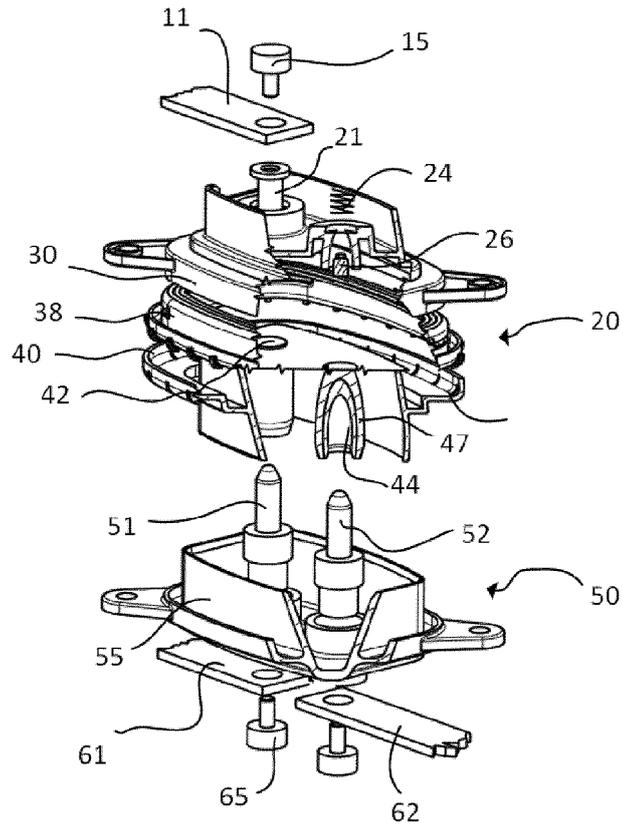


Fig. 4A

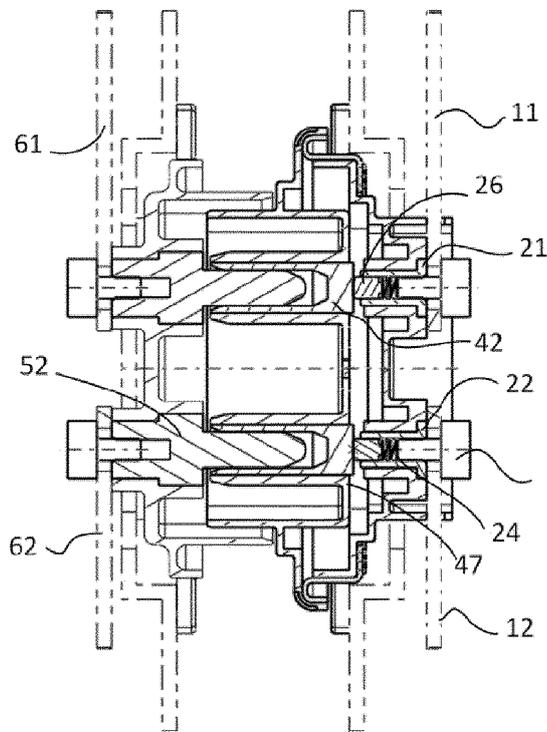


Fig. 4B

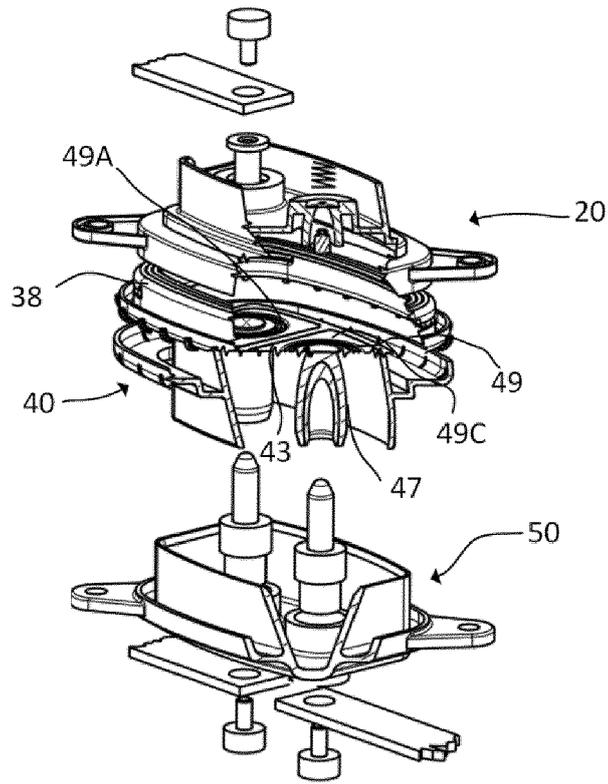


Fig. 5A

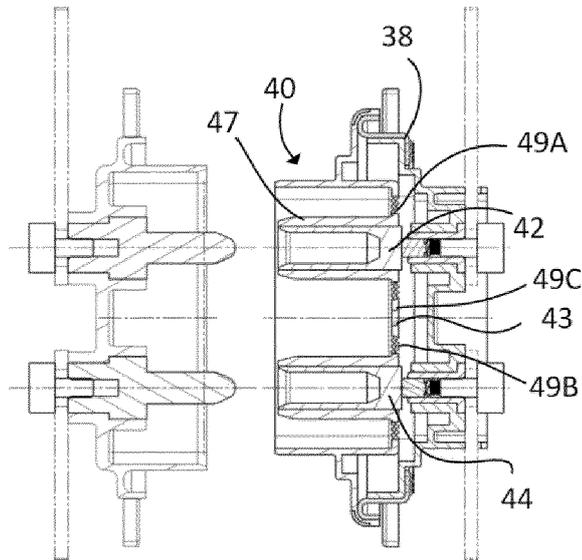


Fig. 5B



EUROPEAN SEARCH REPORT

Application Number  
EP 19 38 3194

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 769 652 A (WIDER ERIC S [US]) 23 June 1998 (1998-06-23) * page 4, line 66 - page 6, line 53; figures 1,6 *	1-15	INV. H01R24/66 H01R103/00
X	US 2014/170886 A1 (KIKUCHI TAKASHI [US] ET AL) 19 June 2014 (2014-06-19) * paragraph [0043] - paragraph [0062]; figures 1-6 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 June 2020	Examiner Bouhana, Emmanuel
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	

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ON EUROPEAN PATENT APPLICATION NO.**

EP 19 38 3194

5 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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12-06-2020

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	US 5769652	A	23-06-1998	NONE
	-----			
15	US 2014170886	A1	19-06-2014	CN 103872484 A 18-06-2014
				JP 6103917 B2 29-03-2017
				JP 2014120377 A 30-06-2014
				US 2014170886 A1 19-06-2014
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