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(54) **Shielded electrical plug-in connector**

(57) The present invention relates to a shielded electrical plug-in connector (1) having a connector portion (2) comprising at least one contact element (6) adapted to contact a mating contact element (46) of the mating plug (41), a sealing element (9) arranged along a circumference (10,50) of the connector portion (2,42), and an essentially tubular shield contact member (11) adapted to contact a mating shield contact member (51) of the mating plug (41), the tubular shield contact member (11) surrounding at least a part of the at least one contact element

(6), and being electrically isolated from the at least one contact element (6), as well as a shielded electrical mating plug-in connector (41) adapted to be mated with a shielded electrical plug-in connector (1). The present invention provides that the tubular shield contact member (11) comprises at least one support element (12), the support element supporting the sealing element (9) in a direction parallel to the plug-in direction (P) and that the mating shield contact member (51) is provided with a plurality of at least one of distancing elements (52').

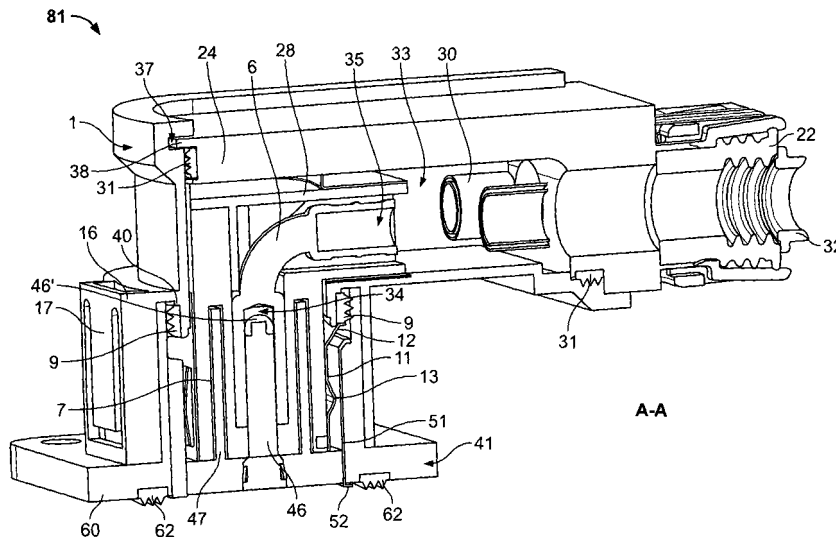


Fig. 10

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Description

[0001] The present invention relates to a shielded electrical plug-in connector having a connector portion adapted to be mated with a mating plug in a plug-in direction, the connector portion comprising at least one contact element adapted to contact a mating contact element of the mating plug, a sealing element arranged along a circumference of the connector portion, and an essentially tubular shield contact member adapted to contact a mating shield contact member of the mating plug, the tubular shield contact member surrounding at least a part of the at least one contact element, and being electrically isolated from the at least one contact element.

[0002] Further, the present invention relates to a shielded electrical mating plug-in connector adapted to be mated with a shielded electrical plug-in connector, wherein the mating shield contact member is tubular.

[0003] Shielded electrical plug-in connectors having shield contact members and comprising sealing elements as the plug-in connector mentioned above, are known. For example, in automotive applications, especially electrically driven motor vehicles, they are used for connecting high-voltage/high-current batteries to an on-board power supply. These batteries are often provided with a power convertor converting direct current (DC) taken from the battery cells to alternating current (AC) which is required by the drive motors of the electrical vehicles. The AC-power may flow in both directions either from or to the battery and its power convertor, respectively.

[0004] The AC-power being transmitted via lines connected to the plug-in connectors and the connectors themselves emit electromagnetic interference signals which may disturb other electrical and electronic systems in the surroundings of the connector and the lines attached thereto: These other systems may be arranged inside and outside the vehicle and have to be protected from the electromagnetic interference signals. Therefore, the connector and the lines attached thereto are provided with an electromagnetic shielding encompassing the power conducting elements. The electromagnetic shielding picks up and blocks the electromagnetic interference signals for leading their energy to a ground potential connection where it may be dissipated without any interference with adjacent electrical or electronic systems. The shielding should completely surround the power lines for preventing any leakage of electromagnetic interference signals to the outside of the connector or the power lines attached thereto.

[0005] In order to lead the electromagnetic interference signals to a ground potential via the shielding, the shielding of the plug-in connector and the power lines attached thereto as well as the shielding of a mating plug-in, connector and the line attached thereto have to be unbrokenly connected. Therefore, the connectors are provided with shield contact members, which are adapted to contact each other when the connectors are fully mated.

[0006] The plug-in connectors are often used in hostile environments, as when they are applied in vehicles, they are exposed to vibrations, moisture, dirt, dust and possibly chemically aggressive substances. When aggressive, corroding or electrically conducting substances would get into a connection area between mating contact elements of the connector and a respective mating connector, they could cause interruptions of the power supply or short circuits. Hence, the connectors have to be closed and provided with sealings which prevent any harmful substances from entering the connector and affecting the contact elements arranged therein. It is desired to hermetically seal the connector. An overall sealing should at least be liquid-tight and optimally gas-tight.

[0007] A shielded electrical connector according to the prior art is described in the European patent application EP1883135 A1 for example. A connector portion of this connector comprises two tubular shield contact members each surrounding a contact element and being in electrical contact with a shielding for a line. An outer circumference of the connector portion is provided with a sealing.

[0008] Known connectors as mentioned above and described in the prior art suffer from the disadvantages that they comprise a high number of single components and cannot comply with the high demands to durability and reliability. The high number of parts and other constructive deficiencies impair their resistance against harmful environmental conditions, as well as their accuracy and handling. A lacking accuracy causes major failures such as leakage and contact interruption.

[0009] In view of the disadvantages of the prior art mentioned above, an object underlying the invention is to provide a shielded electrical plug-in connector which is hermetically sealable and reliable, yet easy to use and to assemble.

[0010] This object is achieved according to the invention for the shielded electrical plug-in connector mentioned in the beginning of the introduction in that the tubular shield contact member comprises at least one support element which is supporting the sealing element in a direction parallel to the plug-in direction.

[0011] For a shielded electrical mating plug-in connector mentioned in the beginning of the description, the object is achieved according to the present invention in that the mating shield contact member is provided with a plurality of at least one of distancing elements projecting inwardly from an inner circumference of the mating shield contact member, and distancing elements projecting outwardly from an outer circumference of the mating shield contact member.

[0012] These simple solutions provide that the shielded electrical plug-in connector and a respective shielded electrical mating plug-in connector may be mated very precisely while all parts which are brought into mesh with each other like the contact elements, shielded contact members and sealing elements, are accurately kept in place for precisely engaging each other. Further, the at

least one support element of the tubular shield contact member secures the sealing and prevents the sealing from getting out of place as at the same time it helps to center the plug-in connector in respect to the mating plug-in connector. The distancing elements protruding from at least one of the inner and outer circumference of the mating shield contact member again help to center the mating tubular shield contact member in the mating plug-in connector and therefore improve the accuracy of the entire connector. Hence, the shielded electrical mating plug-in connector and its mating plug fit closely and precisely. The close fit may be repeated accurately many times making the connector very durable and reliable.

[0013] The solutions according to the invention can be combined as desired and further improved by the following further embodiments that are advantages on their own in each case:

[0014] According to a first possible further embodiment of the shielded electrical or plug-in connector, the sealing element is immobilized between the at least one support element and a stopping means. Hence, the sealing element is accurately fastened and may not get out of place in any direction. Thereby, the accuracy and sealing of a shielded electrical plug-in connector according to the present invention is further improved.

[0015] According to another further possible configuration, the at least one support element is formed as a protrusion that extends from the tubular shield contact member and abuts the sealing element. The protrusion may be a lug for example which projects in a direction transverse or angular to the plug-in direction for holding the sealing element in place but still having a certain resiliency. As it abuts the sealing element, the proper fit of the sealing element is ensured.

[0016] According to another possible further embodiment, the accuracy in fit and resistance against vibrations may be further improved when the tubular shield contact member comprises a plurality of at least one of inner spring contact elements projecting radially inwardly and spaced along an inner circumference of the tubular shield contact member, and outer spring contact elements projecting radially outwardly and spaced along an outer circumference of the tubular shield contact member. These spring contact elements have a certain resiliency and help to position and hold the tubular shield contact member in the connector portion of the plug and the shield contact member of a mating plug. By exerting a certain contact force in a direction perpendicular to the plug-in direction the spring contact elements improve the electrical connection as well as the mechanical stability of the shield contact member and encompassing or engaging elements.

[0017] The spring contact elements of the tubular shield contact member may be produced very easily and have a high durability when according to another further possible embodiment of the invention, the spring contact elements are formed as at least one of resilient lamellas and lugs, at least partially extending transverse to the

plug-in direction. Thereby, the spring contact members are somehow bevelled and help to engage or introduce the tubular shield contact member into a mating plug. The spring contact elements are prevented from jamming, bending or even breaking as they gently slide into the right position along inclined surfaces formed by the transverse or inclined section of the resilient lamellas or lugs.

[0018] The number of parts within a shielded electrical plug-in connector may be reduced according to another further possible embodiment of the present invention, if the connector portion comprises at least two contact elements adapted to contacts two respective mating contact elements of the mating plug, the at least two contact elements being at least partially surrounded by the tubular shield contact member. Therefore, each contact element does not have to be provided with a shield contact member on its own. Using one tubular shield contact member for a plurality of contact elements is also advantageous because the shield contact member helps to center the plug in respect to a mating plug and therefore centers a plurality of contact elements at the same time. If the contact elements would each have a tubular shield contact member the danger of jamming one of the shield contact members or contact elements is increased. Hence, one tubular shield contact member surrounding or encompassing a plurality of contact elements helps to improve the overall accuracy and reliability of a shielded electrical plug-in connector.

[0019] According to another further possible embodiment, a shield electrical plug-in connector is provided with a line connecting portion comprising an electromagnetic shielding surrounding at least a part of at least two line connecting members for contacting an electrical line, the shielding being in electrical contact with the tubular shield contact member. As mentioned in the beginning of the description, the electromagnetic shielding prevents the emission of electromagnetic interference signals. As the shielding is in electrical contact with the tubular shield contact member an unbroken connection of the electromagnetic shielding within the connector and the lines attached thereto is ensured. To surround or envelope a plurality of conducting elements such as the line connecting members by a shielding helps to reduce the number of parts within the shielded electrical plug-in connector. The line connecting members may be adapted such that they facilitate connecting the plug-in connector to an electrical line, such as wire or other types of electrical conductors. The arrangement of the line connecting members within a line connecting portion helps to provide all means for making the connection between the line and the connecting members reliable and durable. The line connecting members may be formed integrally with the contact elements but may have additional mechanical features for ensuring a mechanically and electrically reliable contact to the electrical line.

[0020] A shielded electrical plug-in connector according to the present invention may be easily sealed and

protected from harmful chemical as well as mechanical environmental influences when pursuant to another further possible embodiment it is provided that the line connecting portion and the connector portion are accommodated in a receptacle formed by a housing, the receptacle being closed by a cover that is sealingly slid into at least one groove of the housing. The receptacle within the housing provides a clean and safe accommodation of the contact elements included in the line connecting portion and the connector portion. Further, closing the housing by a cover that is sealingly slid into a groove of the housing is an easy and reliable way to lock the receptacle.

[0021] A hermetically, i.e. liquid-tight and gas-tight, sealing of the receptacle within the housing is facilitated if pursuant to another possible further embodiment of a shield electrical plug-in connector according to the present invention, it is provided that the connector comprises an angled sealing element for sealing the cover against the housing. The angled sealing element may be tightly fitted on the cover or adjacent to the at least groove receiving the cover. Thereby, one side of the angled sealing may already get in contact with the cover while it is being slid along the groove. The other part of the sealing may abut to the cover or housing when the cover has been slid into a closed position where an opening to the receptacle within the housing is fully closed by the cover.

[0022] According to another further possible embodiment of a shielded electrical plug-in connector it may be provided, that the line connecting portion is angled with respect to the connector portion. Thereby, the headroom of the connector may be reduced and its handling is improved. Especially, as electrical lines may stick out from the line connecting portion, an angled plug-in connector may better fit in the mechanical environment of the apparatus accommodation it. Therefore, the compactness of the apparatus may be increased while its size can be reduced.

[0023] A shielded electrical mating plug-in connector according to the present invention may be further improved pursuant to another further embodiment, if the distancing elements on the inner or outer circumference of its mating shield contact member are formed as lugs protruding from a rim section of the mating shield contact member in a direction substantially perpendicular to the plug-in direction. By protruding from the circumference possibly from a rim of the mating shield contact member, the lugs constitute means for accurately positioning the mating shield contact member which are easy to produce and to handle. Such as spring contact elements in the form of resilient lamellas or lugs, the distancing element in the form of lugs may be formed in a stamping and bending process in one piece with the shield contact member and the mating shield contact member, respectively.

[0024] The invention will be described in more detail by way of example hereinafter using advantageous embodiments and with reference to the drawings. The described embodiments are only possible configurations in

which the individual features may however, as described above, be implemented independently of each other or may be omitted. Equal elements illustrated in the drawings are provided with equal reference signs. Redundant parts of the descriptions relating to equal elements illustrated in different drawings are left out. In the drawings:

- 5 Fig. 1 is a schematic perspective view of an embodiment of a shielded electrical plug-in connector according to the present invention;
- 10 Fig. 2 is a schematic front view of the shielded electrical plug-in connector shown in Fig. 1;
- 15 Fig. 3 is a schematic side view of the shielded electrical plug-in connector shown in Figs. 1 and 2;
- Fig. 4 is a schematic top view of the shielded electrical plug-in connector shown in Figs. 1 to 3;
- 20 Fig. 5 is a schematic perspective exploded view of the shielded electrical plug-in connector shown in Figs 1 to 4;
- 25 Fig. 6 is a schematic cross sectional view of the shielded electrical plug-in connector shown in Figs. 1 to 4 along an inter section line A-A depicted in Fig. 2;
- 30 Fig. 7 is a schematic perspective view of an embodiment of a shielded electrical mating plug-in connector according to the present invention;
- 35 Fig. 8 is a schematic perspective view of the shielded electrical plug-in connector shown in Figs. 1 to 4 being fully mated with the shielded electrical mating plug-in connector shown in Fig. 7 such that they constitute an electrical connector according to the invention;
- 40 Fig. 9 is another schematic perspective view of the connector shown in Fig. 8;
- 45 Fig. 10 is a schematic perspective cross sectional view of the connector shown in Fig. 9 along the intersection line A-A depicted in Fig. 2;
- Fig. 11 is a schematic perspective cross sectional view of the connector shown in Fig. 9 along an intersection line C-C depicted in Fig. 2.
- 50 Fig. 12 is a schematic perspective view of an embodiment of a tubular shield contact member according to the invention;
- 55 Fig. 13 is a schematic perspective view of an embodiment of a mating shield contact member according to the invention;

Fig. 14 is a schematic perspective view of the shield contact member shown in Fig. 12 being mated with the mating shield contact member shown in Fig. 13;

Fig. 15 is a schematic perspective cross sectional view of the connector shown in Fig. 9 along an intersection line B-B depicted in Fig. 2.

[0025] A construction of a shielded electrical plug-in connector 1 according to the invention will firstly be described in the following with reference to fig. 1 which shows a schematic perspective view of the shielded electrical plug-in connector 1. The plug-in connector 1 has a connector portion 2 adapted to be mated with a mating plug (not yet shown) in a plug-in direction P. The connector portion 2 is formed as a connector jack having an opening 3. The opening 3 forms a cavity for a contact housing 4 being arranged centrally within the opening 3.

[0026] The contact housing 4 is provided with two contact receptacles 5 being formed as recesses, cavities or throughholes. Within each contact receptacle 5 a contact element 6 is arranged which is formed as socket for accommodating a mating plug-in contact pin (not yet shown) of a mating plug (not yet shown).

[0027] Further, the contact housing 4 is provided with two stabilizing means 7 each having the form of a circular groove being arranged coaxial to the contact receptacles. The stabilizing means 7 being formed as a groove together with the contact receptacles 5 constituting a cavity are forming a support means 8 therebetween a longitudinal axis of which is running in the plug-in direction P and which has the form of a tubular column.

[0028] At the bottom of the opening 3 accommodating the contact housing 4 a sealing element 9 having the form of a sealing ring is arranged, which is arranged along a circumference of the connector portion 2.

[0029] A tubular shield contact member 11 is arranged along the circumference 10 of the contact housing 4. The tubular shield contact member 11 is provided with a plurality of support elements 12 which are formed as protrusions or lugs that extend radially from the tubular shield contact member 11 in a direction transverse to the plug-in direction P. The support elements 12 abut the sealing element 9 thereby stabilizing the sealing element 9 in the plug-in direction P such that it is blocked and immobilized.

[0030] Further, the shield contact member 11 is provided with spring contact elements 13, 13' which are formed as resilient lamellas 13 and lugs 13' extending from the shield contact member 11 in a direction transverse to the plug-in direction P. The spring contact elements 13, 13' serve to contact a mating shield contact member (not yet shown) of a mating plug (not yet shown) and to support and center the shield contact member 11 at the contact housing 4, respectively.

[0031] An outer wall 14 of the connector portion 2 is a part of a housing 15 of the shielded electrical plug-in connector 1. In the outer wall 14 of the connector portion 2

a positioning assistance 16 is formed which serves as a polarization and helps to position the connector portion 2 on a mating plug (not yet shown) in a such a way that the contact elements 6 are accurately mated with the mating contact elements (not yet shown) of the mating plug (not yet shown). The positioning assistance 16 is provided with a latching spring 17 for a catch (not yet shown) of the mating plug (not yet shown) which serves to lock the connector in an end position E where it is fully mated with a mating plug-in connector (not yet shown).

[0032] Further, for security reasons the connector portion 2 is provided with an interlock means 18 being formed as a interlock spring which serves to short circuit the contact elements 6 by switch closing them when the plug-in connector 1 is not fully mated with a mating plug-in connector (not yet shown). The interlock means 18 is arranged within an interlock receptacle 19 formed as a cavity within the contact housing 4 which opens in the plug-in direction P.

[0033] The plug-in connector 1 is provided with a line connecting portion 20 which is provided with line openings 21 which serve to lead electrical lines in the form of wires into the housing 15. The line openings 21 are formed as tubes having gaskets 22 at their rims. The gaskets 22 serve to seal up the line openings 21 against an electrical line (not shown).

[0034] The plug-in connector 1 is further provided with attachment means 23 which to serve to fasten the connector in an apparatus. The attachment means 23 are arranged in the vicinity of the line openings 21. The line openings 21 and attachment means 23 are integrally formed with a cover 24 of the housing 15.

[0035] The cover 24 is provided with a latching means 25 which engages with a catch 26 of the housing 15 in a closed position C where the cover 24 is fully mated with the housing 15.

[0036] Fig. 2 shows a schematic front view of the shielded electrical plug-in connector 1 illustrated in Fig. 1. In Fig. 2 it becomes apparent how the support elements 12 and spring contact elements 13, 13' protrude radially from the shield contact member 11. The shield contact member 11 encompasses or envelopes the contact housing 4 for accommodating the contact elements 6 and is electronically isolated from the contact elements 6 by the contact housing 4. Further, it becomes apparent that the stabilizing means 7 and support means 8 are concentrically arranged around the contact elements 6.

[0037] The sealing element 9 is formed such that it fits closely to the inner side of the outer wall 14 of the connector portion 2 as well as a circumference of the housing 15.

[0038] Further, it becomes evident from Fig. 2 that the catch 26 of the housing protrudes through the latching means 25 of the cover 24 and that the latching spring 17 protrudes from the position assistance 16 in a direction substantially perpendicular to the plug-in direction P.

[0039] The interlock means 18 is arranged centrally within its interlock receptacle 19 between the two contact

elements 6 for being able to easily short circuit the contact elements when the plug-in connector 1 is not fully mated with a mating plug-in connector (not yet shown) in the endposition E.

[0040] In Fig. 3 the plug-in connector shown in Figs. 1 and 2 is illustrated in a schematic side view. In Fig. 3 it becomes evident that a longitudinal axis L_C of the connector portion 2 is angled with an angle α in respect to longitudinal axis L_L of the line connecting portion 20. In the present case, the angle α is a right angle. Further, a virtual separation of the connector portion 2 and the line connecting portion 20 becomes evident.

[0041] In Fig. 4 the plug-in connector illustrated in Figs. 1 to 3 is shown in a schematic top view. As in Fig. 3, the virtual separation of the connector portion 2 and the line connecting portion 20 becomes evident.

[0042] In Fig. 5 a schematic perspective exploded view of the plug-in connector shown in Figs. 1 to 4 is illustrated. The parts of the plug-in connector are arranged such that they could be assembled by sticking them together. The sealing 9, a cover part 27 of an electromagnetic shielding, an isolating means 28 for isolating the cover part 27 from the contact elements 6, the housing 4, the interlock means 18, a body part 29 of the electromagnetic shielding 27, 29, and the shield contact member 11 are stuck together along the longitudinal axis L_C of the connector portion 2.

[0043] Line attachment means 30 in the form of crimp ferrules have to be mated with the contact elements 6 in a direction parallel to the longitudinal axis L_L of the line connecting portion. The cover 24 of the housing 15, the gaskets 22 for the line openings 21 of the cover, and line protection means 32 in the form of caps are also stuck together in a direction parallel to the longitudinal axis L_L of the line connecting portion 20.

[0044] Further, an angled sealing element 31 is provided for sealing the cover 24 with respect to the housing 15.

[0045] In Fig. 6 a schematic cross sectional view of the shielded electrical plug-in connector 1 shown in Figs. 1 to 4 is illustrated with respect to the intersection line A-A shown in Fig. 2. The contact element 6, the shield contact member 11, and the interlock means 18 are fully mated with the contact housing 4. The contact housing 4 is introduced into a receptable 23 formed by the housing 15.

[0046] A contacting zone 34 of the contact element 6 is formed as a cavity constituting a socket for receiving a mating contact element (not yet shown) of a mating plug (not yet shown) being formed as a plug-in pin. A line connecting section 35 of the contact element is formed as a cavity for receiving an electrical conductor. The section of the contact element 6 comprising the line connecting section 35 provides a line connecting member 36 for connecting an electrical line to a contact element 6.

[0047] The cover 24 of the housing 15 is sealingly slid into a groove 37 of the housing which accommodates a closing member 38 of the cover 24. By sliding the cover

24 into the housing 15 until the cover 24 reaches the closed position C shown in Fig. 6, the angled sealing element 31 is compressed between the cover 24 and the housing 15 such that it provides gas-tight sealing.

[0048] The sealing element 9 sits on an outer circumference of the housing 15 and is being pushed against a stopping means 40 by the support elements 12 of the shield contact member 11. The stopping means 40 is formed as an edge.

[0049] Further, the gaskets 22 are sitting on the tube-like end section of the line openings 21 and abut the line attachment means 30. The cover part 27 of the electromagnetic shielding 27, 29 is electrically isolated from the contact elements 6 with the help of isolating means 28.

[0050] In Fig. 7 a schematic perspective view of an embodiment of a shielded mated electrical mating plug-in connector 41 according to the invention is illustrated. The mating plug-in connector 41 has a mating connector portion 42 which is adapted to be mated with the connector portion 2 of the plug-in connector 1 by inserting the connector portion 2 into the mating connector portion 42 in the plug-in direction P.

[0051] The mating connector portion 42 is provided with an opening 43. Within the opening 43 mating contact elements 46 are arranged which are formed as plug-in pins adapted to be mated with the contact elements 6 of the plug-in connector 1. The mating contact elements 46 are provided with contact protecting means 46' which are formed as contact caps covering tips of the mating contact elements 46. The mating connector portion 42 is further provided with mating stabilizing means 47 having a tubular form which are adapted to be mated with the stabilizing means 7 of the connector portion 2 of the plug-in contact 1.

[0052] A mating housing portion 44 of the mating plug-in connector 41 provides an inner circumference 50 along which a tubular mating shield contact member 51 is placed which is adapted to be mated with the shield contact member 11 of the plug-in connector 1 by inserting the shield contact member 11 into the mating shield contact member 51.

[0053] An outer wall 54 of the mating plug-in connector 41 is provided with a mating positioning assistance 56 which is formed as two tongues running in the plug-in connection P which fit into a square receiving opening constituted by the positioning assistance 16 of the plug-in connector 1. The mating positioning assistance 56 is provided with a catch 57 for the latching spring 17 of the positioning assistance 16.

[0054] Within the opening 43 to the mating connector portion 42 an interlock operating means 58 is provided in form of a mandrel protruding from a bottom 48 of the mating connector portion 42 in a direction opposite to the plug-in direction P. The interlock operating means 58 is shaped in order to operate the interlock means 18 such that it is detached from the contact elements 6 and a plug-in connection between the plug-in connector 1 and the mating plug-in connector 41 is activated.

[0055] Further, the mating plug-in connector 41 is provided with a base 60 which is formed as a base plate a normal of which runs parallel to the plug-in direction. The base 16 is provided with attachment means 63 in the form of holes with the help of which the mating plug-in connector 41 can be fastened to an electrical system such as a battery or power converter.

[0056] In Fig. 8 a schematic perspective view of a connector 81 according to an embodiment of the present invention is illustrated which is constituted by the shielded electrical plug-in connector 1 and the shielded electrical mating plug-in connector 42 which have been plugged together in the plug-in direction P until they are fully mated in the end position E.

[0057] The perspective of Fig. 8 shows an underside of the base 16 of the mating plug-in connector 41. On the underside, the base plate 60 is provided with a gasket 62 surrounding the mating connector portion 42 on the underside of the base 60. With the help of a gasket 62 the mating plug-in connector 41 is sealed against the surface of an electrical system where it is attached to. The perspective in Fig. 8 shows contact receptacles 45 in the form of through holes in the mating housing portion 44 for the mating contact elements 46.

[0058] Further, the mating shield contact member 51 is provided with a plurality of outer distancing elements 12 formed as lugs protruding from a rim section of the mating shield contact member 51. Additional inner distancing elements 52' are provided at an inner circumference of the mating shield contact member 51 which are formed as lugs protruding from a rim section of the mating shield member 51. The inner distancing elements 52' serve to distance and center the mating shield contact member 51 with respect to the contact housing 4 of the plug-in connector. The outer distancing elements 52 serve to distance and center the mating shield contact member 51 with respect to the circumference 50 of the mating housing portion 44 which is provided with centering means 49 in the form of notches running parallel to a plug-in direction P. The centering means 49 accommodate the outer distancing elements 52.

[0059] The inner distancing elements 52' and outer distancing elements 52 may support the mating shield contact member 51 on a surface of an electrical system where the connector A is attached to via the base 60. Moreover, the inner distancing elements 52' catch behind the bottom of the mating housing portion 44 and prevent the mating shield contact member 51 from being pulled out of the opening 43 when the plug-in connector 1 and mating plug-in connector 41 are detached and pulled away from each other in opposite directions parallel to the plug-in direction P.

[0060] In Fig. 9 the connector 81 is illustrated in another schematic perspective view. Here it becomes apparent how the outer wall 14 of the plug-in connector 1 encompasses and thereby covers the outer wall 54 of the mating plug-in connector 41.

[0061] In Fig. 10 a schematic perspective cross sec-

tional view along the intersection line A-A in Fig. 2 of the connector 81 is illustrated. In Fig. 10 it becomes apparent how the contacting zone 34 of the contact element 6 encompasses the mating contacting element 46. The mating stabilizing means 47 of the mating plug-in connector 41 engage with the stabilizing means 7 of the plug-in connector 1.

[0062] The shield contact member 11 is inserted into the mating shield contact member 51 and the spring contact elements 13 contact the mating shield contact member 51 on its inner circumference.

[0063] Further, the outer distancing elements 52 of the mating shield contact member 51 and lamellas on the gasket 62 on the bottom of the base 60 protrude downwardly from the base 60 such that they may sealingly abut a surface of a system where the connector 81 is attached to.

[0064] In Fig. 11 another schematic perspective cross sectional view of an embodiment of the connector 81 is illustrated. Fig. 11 shows a cross section along the line C-C in Fig. 2. From Fig. 11 it becomes apparent how the isolating means 28 surrounds the contact elements 6 such that they are electrically isolated from the electromagnetic shielding 29, 30. Again it becomes apparent how the support elements 12 of the shield contact member 11 push the sealing 9 towards the stopping means 40 such that the sealing is immobilized and securely seals the plug-in connector 1 with respect to the plug-in connector 41. The shield contact member 11 is centered and in elastical contact with the mating shield contact member 51 with the help of the spring contact elements 13 which resiliently abut to the mating shield contact member 51.

[0065] Further, it becomes apparent in Fig. 11 that the groove 37 in the housing 15 of the plug-in connector 1 runs along an entire upper section of the housing 15 and accommodates the closing member 38 of the cover 24 of the housing 15. The angled sealing element 31 provides a press-tight sealing of the cover 24 in respect to the housing 15.

[0066] In Fig. 12 and Fig. 13 a schematic perspective view of the tubular shield contact member 11 and the tubular mating shield contact member 51, respectively, is illustrated. Here it becomes apparent how the spring contact elements 13 and 13' protrude from an outer and inner circumference of the shield contact member 11, respectively. The spring contact elements 13 form contact areas 13" with which they can abut the inner circumference of the mating shield contact member 51.

[0067] In Fig. 14 the shield contact member 11 and the mating shield contact member 51 are illustrated in a schematic perspective view as they are fully mated in the end position E. Here it becomes apparent how the support elements 12 protrude outwardly from the outer circumference of the tubular shield contact element 11 such that they run transverse to the plug-in direction P and the longitudinal axis L_C of the connector portion 2 and jut above an outer circumference of the mating tubular shield contact member 51.

[0068] The spring contact elements 13, 13' of the shield contact member 11 elastically about the inner circumference of the mating shield contact member 51. As the spring contact elements 13, 13' are distributed along the circumference of the shield contact member 11 and are equally spaced such that they protrude from the outer circumference of the tubular shield contact member 11 in a plane a normal of which runs parallel to the plug-in direction P, the spring contact elements 13, 13' may center the shield contact member 11 within the mating shield contact member 51. The spring contact elements 13, 13' are arranged at different heights of the shield contact member 11 in respect to the plug-in direction P and provide a stable hold of the shield contact member 11 within the mating shield contact member 51 and on the outer circumference of the contact housing 4.

[0069] In Fig. 15 another schematic view of an embodiment of the connector 81 according to the present invention is illustrated. The cross sectional view of Fig. 15 is taken along the intersection line C-C in Fig 2. The plug-in connector is fully mated with the mating plug-in connector 41 such that they are in then end position E.

[0070] From Fig. 15 it becomes apparent, that in the end position E the latching spring 17 on the plug-in connector engages with the catch 57 on the mating plug-in connector 48 such that they are locked and secured from being torn apart in opposite directions parallel to the plug-in direction P.

[0071] The interlock operating means 58 of the mating plug-in connector 41 is inserted in the interlock receptacle 19 of the plug-in connector 1 such that it operates the interlock means 18 and detaches it from the contact elements 6.

[0072] The spring contact element 13' not only helps to center the shield contact member 11 with respect to the mating shield contact member 51 when being inserted thereto, but also engages with a groove 10' on the outer circumference of the housing 4 of the plug-in connector 1 such that the shield contact member 11 is secured and centered with respect to the contact housing 4.

[0073] Deviations from the above-described embodiments are possible within the inventive idea. The plug-connector and mating plug-in connector 51 may be designed as plugs or jacks, respectively, as long as they are adapted to be mated. Hence, the connector portion 2 and the mating connector portion 42 may take any form that enables an engagement of the connector portion with a mating connector portion 42. Consequently, the openings 3, 43 may have any shape that is advantageous for providing a good connectability of the plug-in connector 1 and the mating plug-in connector 41. Accordingly also the shapes of the contact receptacles 5, stabilizing means 7, mating stabilizing means 47 and support means 8 may be varied how it is deemed most appropriate. The sealing element 9 may take any form and may be seated on inner or outer circumferences.

[0074] It is not mandatory that the tubular shield contact member 11 and the mating tubular shield contact

member 51 have an elliptical tubular shape as illustrated in the accompanying drawings. Other tubular shapes with square or otherwise polygonal shapes are also regarded as being tubular as long as they are closed and continuous along a circumference. However, notches or gaps within the circumference 10, 15 may be possible if an enveloping electromagnetic shielding is still provided.

[0075] The support elements 12, spring contact elements 13, 13' and distancing elements 52, 52' may take any form that is appropriate to fulfill the tasks of securing the sealing element 9 as well as centering, contacting and distancing the shield contact member 11 and mating shield contact member 51 with respect to each other and the contact housing 4 and mating housing portion 44.

[0076] The position assistance 16, mating positioning assistance 56, latching spring 17, catch 57, interlock means 18, interlock operating means 58, and interlock receptacle 19 may have any form as long as they are acting in syne and fulfill their task. Further, the line connecting portion 20, base 60, line openings 21 and gaskets 22, 62 may have desired form and shape. The connector 81 may be provided with all types attachment means 23 as desired.

[0077] The housing 15 may have any form as long as it matches with the cover 24 which may be provided with all types of latching means 25 adapted to engage with catches 26 of the housing 15. The cover part 27 of the electromagnetic shielding 27, 29 and the body part 29 of the electromagnetic shielding 27, 29 may be formed however it is appropriate to surround, envelope or encompass the contact element 6 and especially its line connecting section 35.

35 Claims

1. Shielded electrical plug-in connector (1) having a connector portion (2) adapted to be mated with a mating plug (41) in a plug-in direction (P), the connector portion (2) comprising
 - at least one contact element (6) adapted to contact a mating contact element (46) of the mating plug (41), a sealing element (9) arranged along a circumference (10, 50) of the connector portion (2, 42), and an essentially tubular shield contact member (11) adapted to contact a mating shield contact member (51) of the mating plug (41), the tubular shield contact member (11) surrounding at least a part of the at least one contact element (6), and being electrically isolated from the at least one contact element (6),
 - characterized in that** the tubular shield contact member (11) comprises at least one support element (12) supporting the sealing element (9) in a direction parallel to the plug-in direction (P).
2. Shielded electrical plug-in connector (1) according

- to claim 1, **characterized in that** the sealing element (9) is immobilized between the at least one support element (12) and a stopping means (40).
3. Shielded electrical plug-in connector (1) according to claim 1 or 2, **characterized in that** the at least one support element (12) is formed as a protrusion that extends from the tubular shield contact member (11) and abuts the sealing element (9). 5
 4. Shielded electrical plug-in connector according to one of claims 1 to 3, **characterized in that** the tubular shield contact member (11) comprises a plurality of at least one of inner spring contact elements (13, 13') projecting radially inwardly and spaced along an inner circumference of the tubular shield contact member (11) and outer spring contact elements (13, 13') projecting radially outwardly and spaced along an outer circumference of the tubular shield contact member (11). 10
 5. Shielded electrical plug-in connector (1) according to claim 4, **characterized in that** at least one of the inner and outer spring contact elements (13, 13') are formed as at least one of resilient lamellas and lugs, that at least partially extend transverse to the plug-in direction (P). 15
 6. Shielded electrical plug-in connector (1) according to one of claims 1 to 5, **characterized in that** the connector portion (2) comprises at least two contact elements (6) adapted to contact two respective mating contact elements (46) of the mating plug (41), the at least two contact elements (6) being at least partially surrounded by the tubular shield contact member (11). 20
 7. Shielded electrical plug-in connector (1) according to one of claims 1 to 6, **characterized in that** it is provided with a line connecting portion (20) comprising an electromagnetic shielding (27, 29) surrounding at least a part of at least two line connecting members (36) for contacting an electrical line, the shielding (27, 29) being in electrical contact with the tubular shield contact member (11). 25
 8. Shielded electrical plug-in connector (1) according to claim 7, **characterized in that** the line connecting portion (20) and the connector portion (2) are accommodated in a receptacle (33) formed by a housing (15), the receptacle (33) being closed by a cover (24) that is sealingly slid into at least one groove (37) of the housing (15). 30
 9. Shielded electrical plug-in connector (1) according to claim 8, **characterized in that** it comprises an angled sealing element (31) for sealing the cover (24) against the housing (15). 35
 10. Shielded electrical plug-in connector according to one of claims 7 to 9, **characterized in that** the line connecting portion (20) is angled with respect to the connector portion (2). 40
 11. Shielded electrical mating plug-in connector (41) adapted to be mated with a shielded electrical plug-in connector (1) according to one of claims 1 to 10, wherein a mating shield contact member (51) is tubular, **characterized in that** the mating shield contact member (51) is provided with a plurality of at least one of distancing elements (52') projecting inwardly from an inner circumference of the mating shield contact member (51), and distancing elements (52) projecting outwardly from an outer circumference of the mating shield contact member (51). 45
 12. Shielded electrical mating plug-in connector (51) according to claim 11, **characterized in that** the distancing elements (52, 52') are formed as lugs protruding from a rim section of the mating shield contact member (51) in a direction substantially perpendicular to the plug-in direction (P). 50

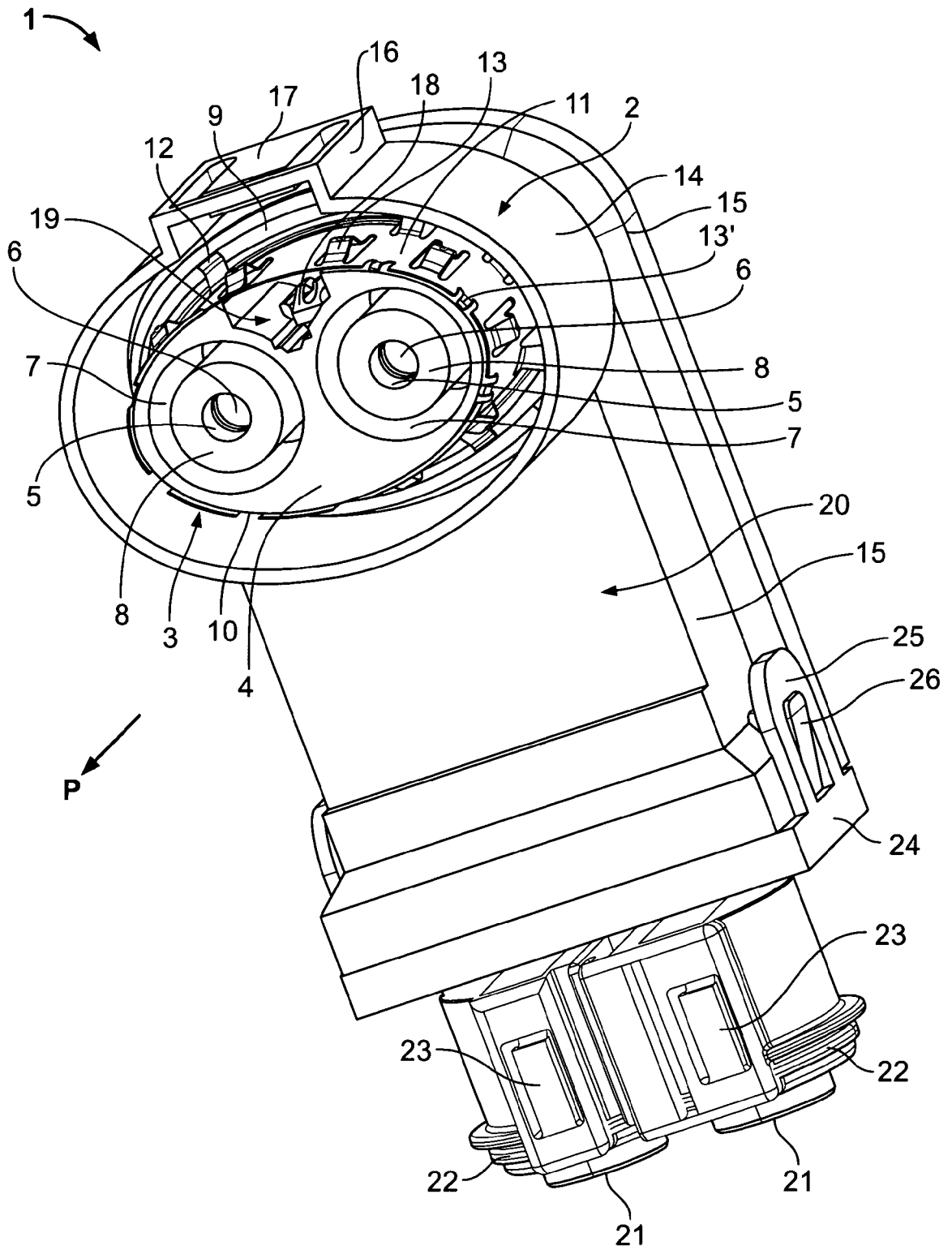


Fig. 1

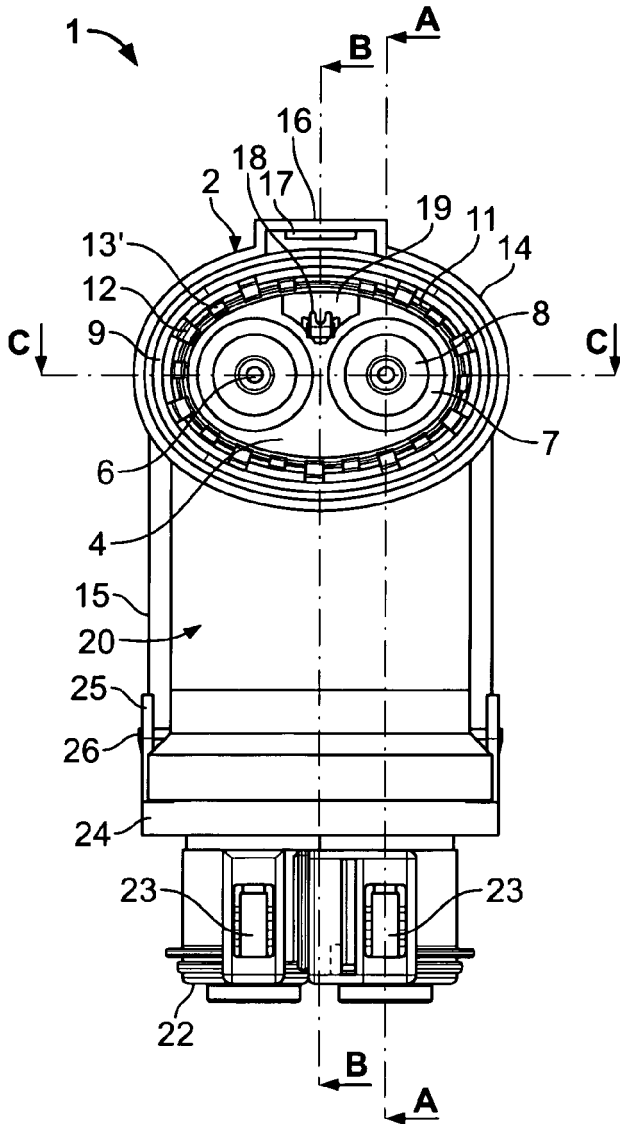


Fig. 2

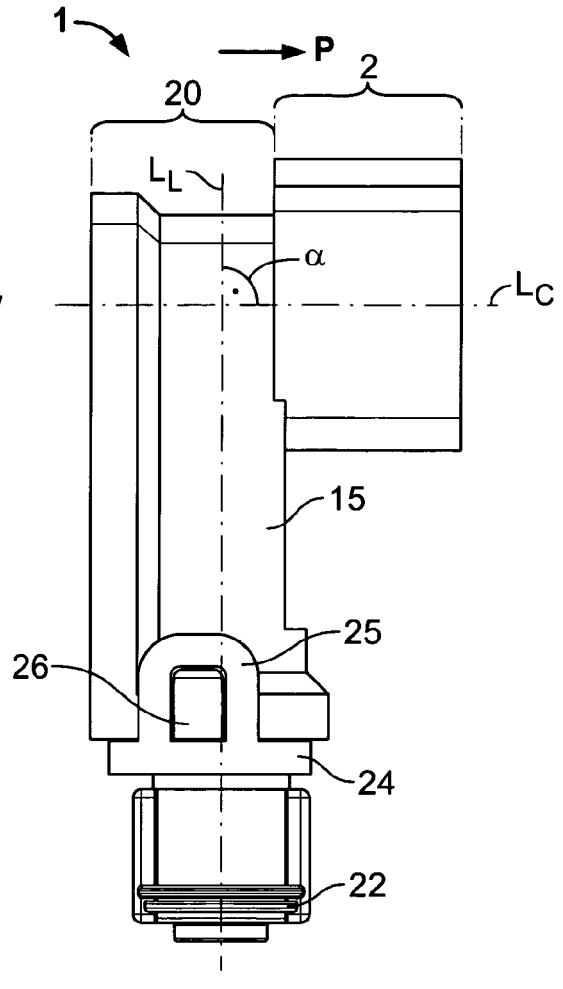


Fig. 3

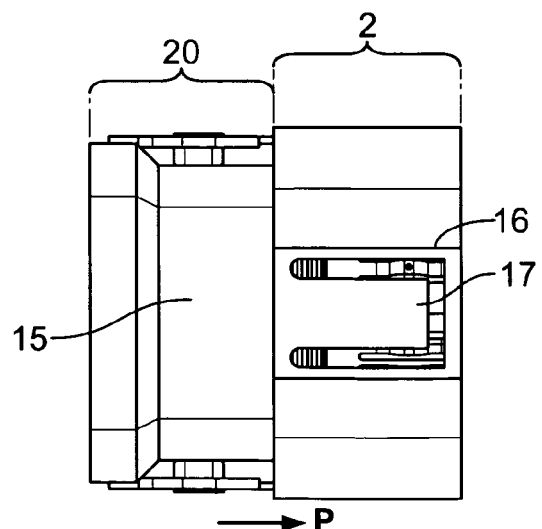


Fig. 4

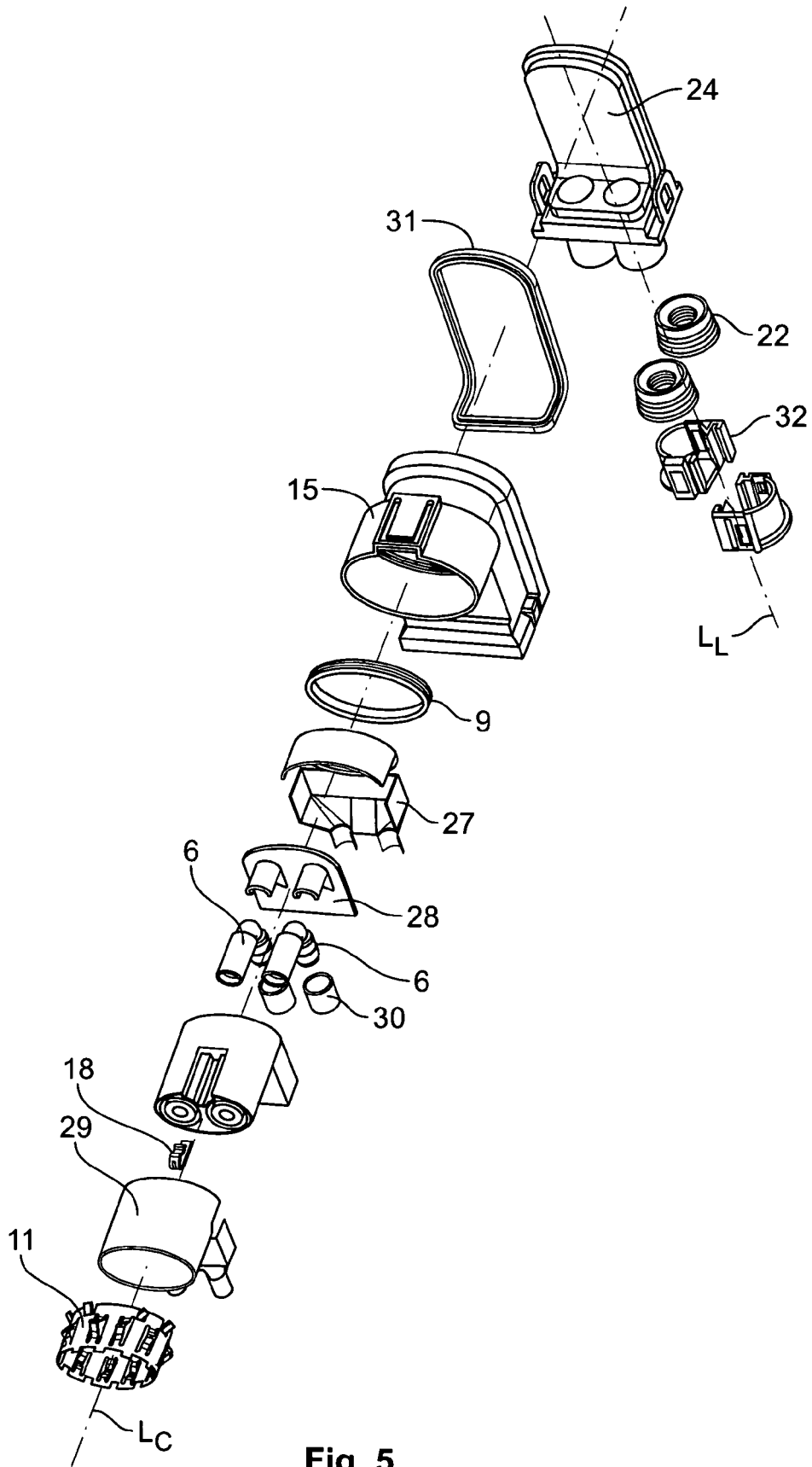


Fig. 5

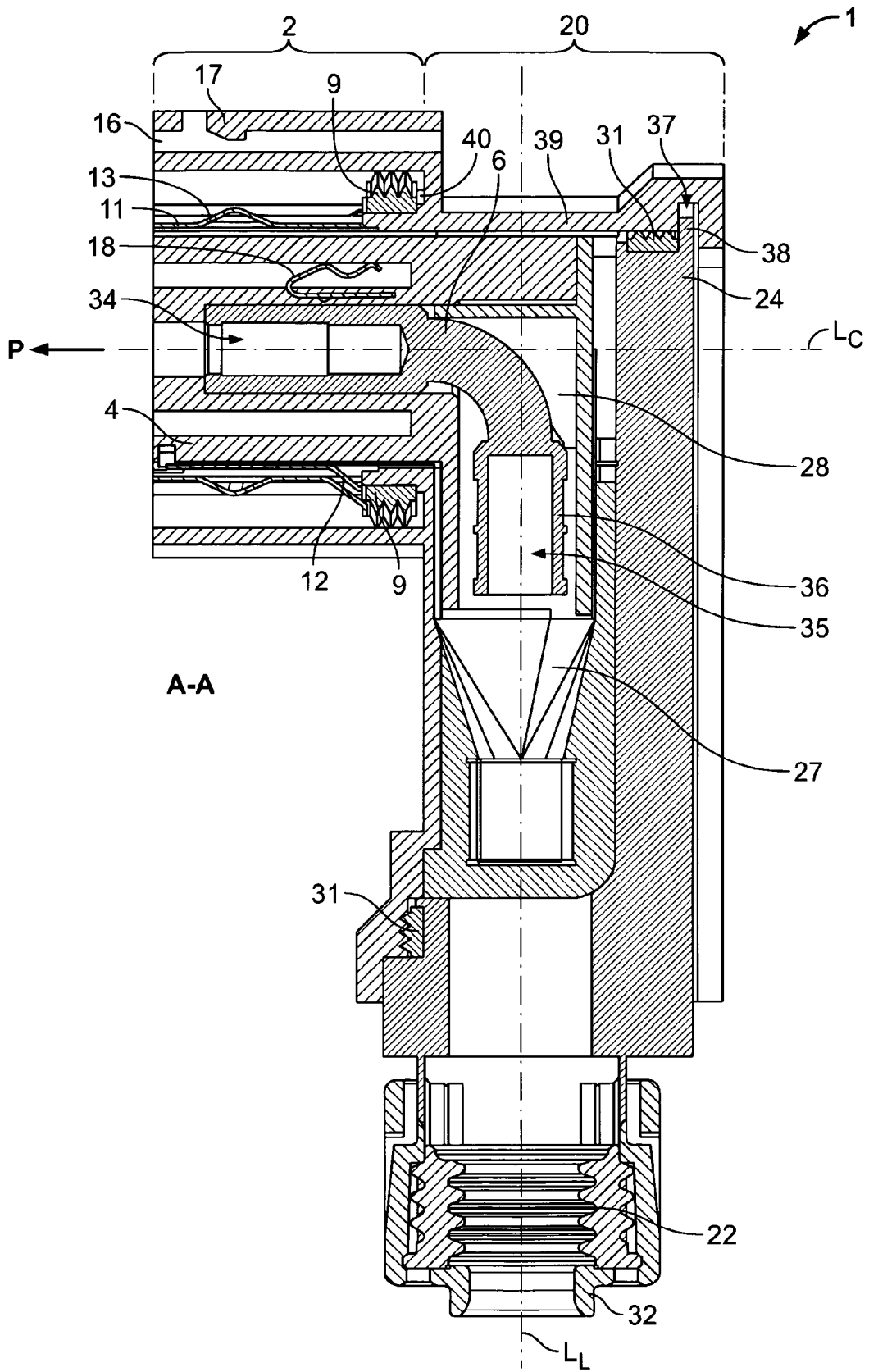


Fig. 6

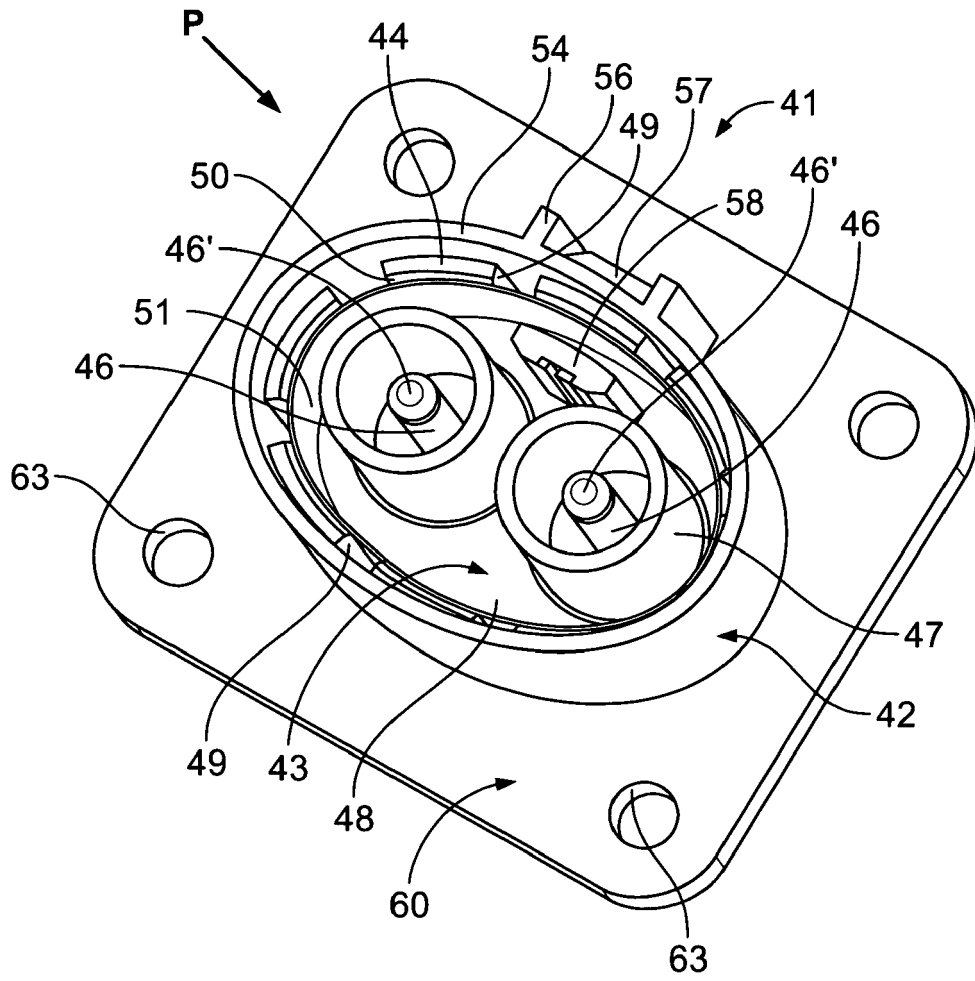


Fig. 7

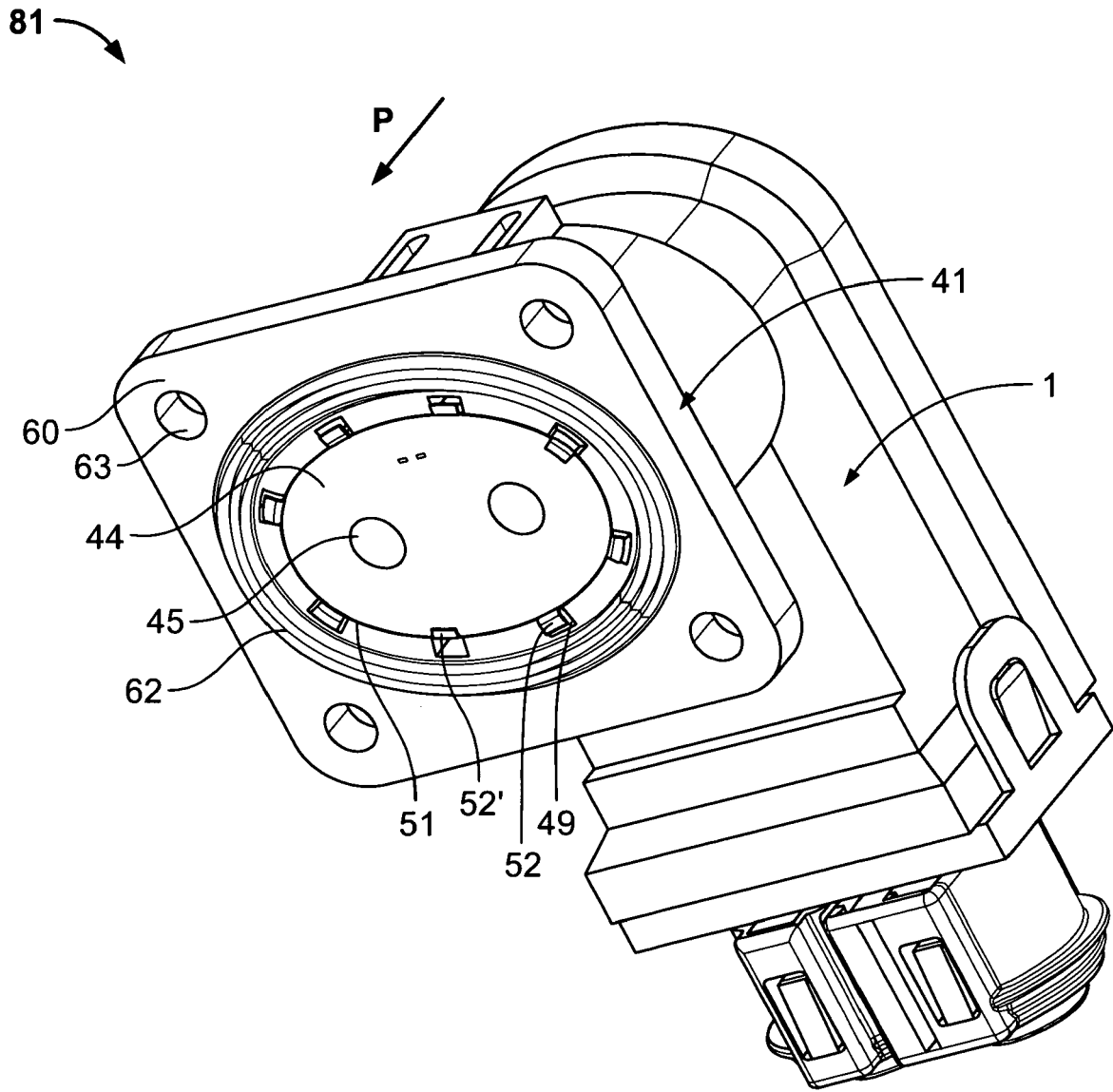


Fig. 8

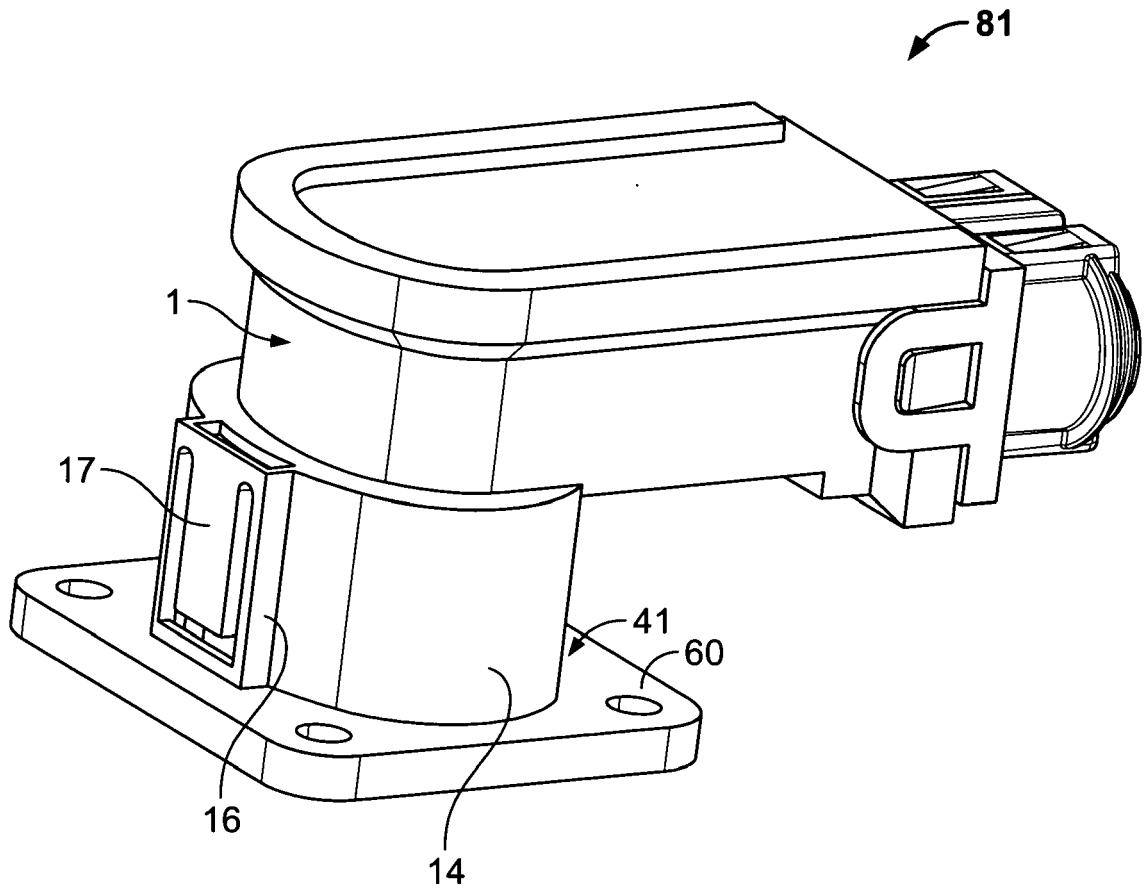
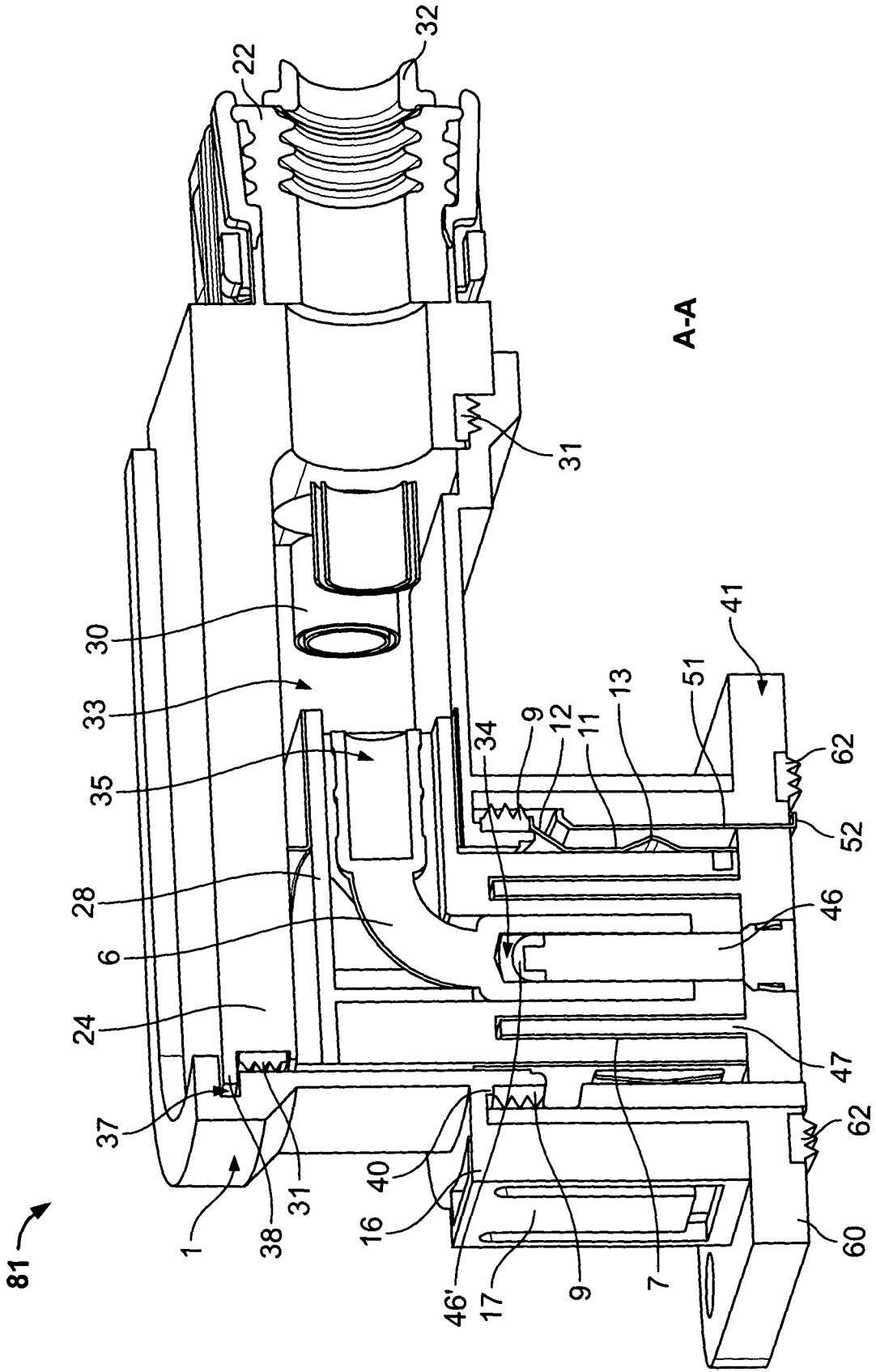


Fig. 9



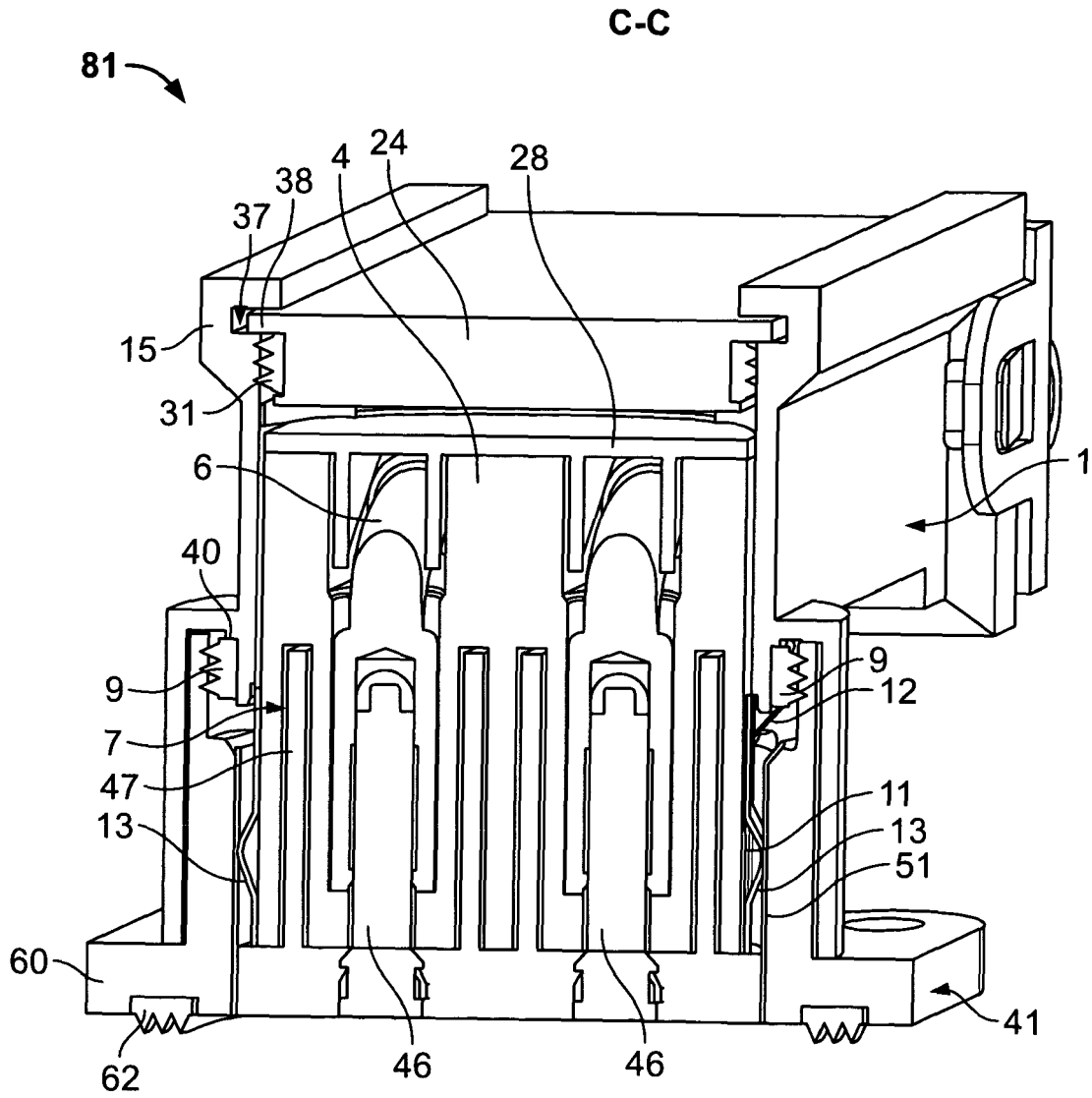


Fig. 11

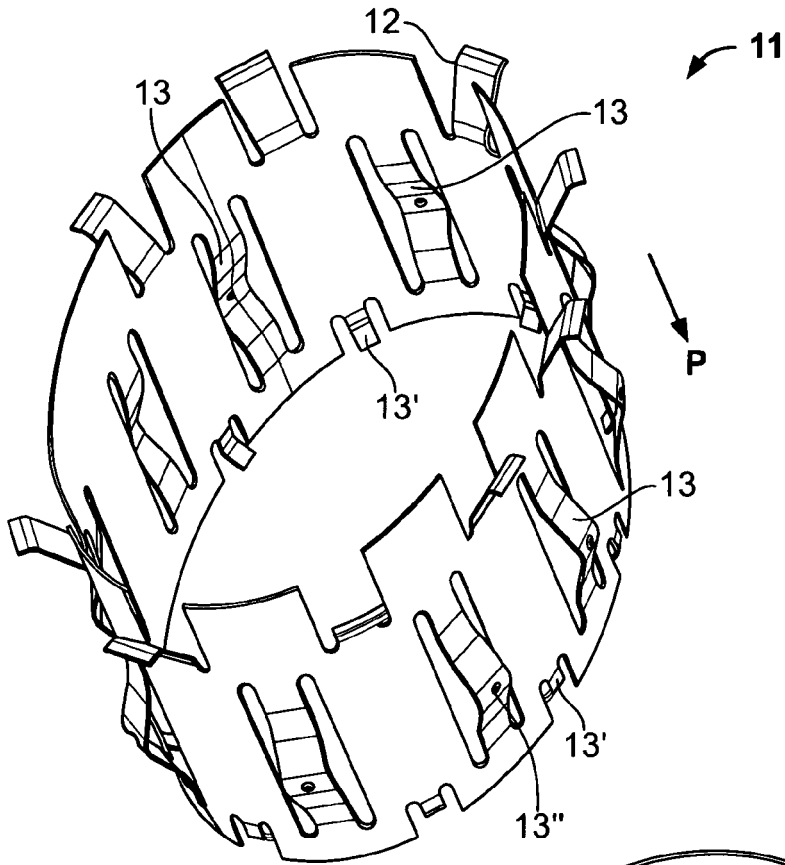


Fig. 12

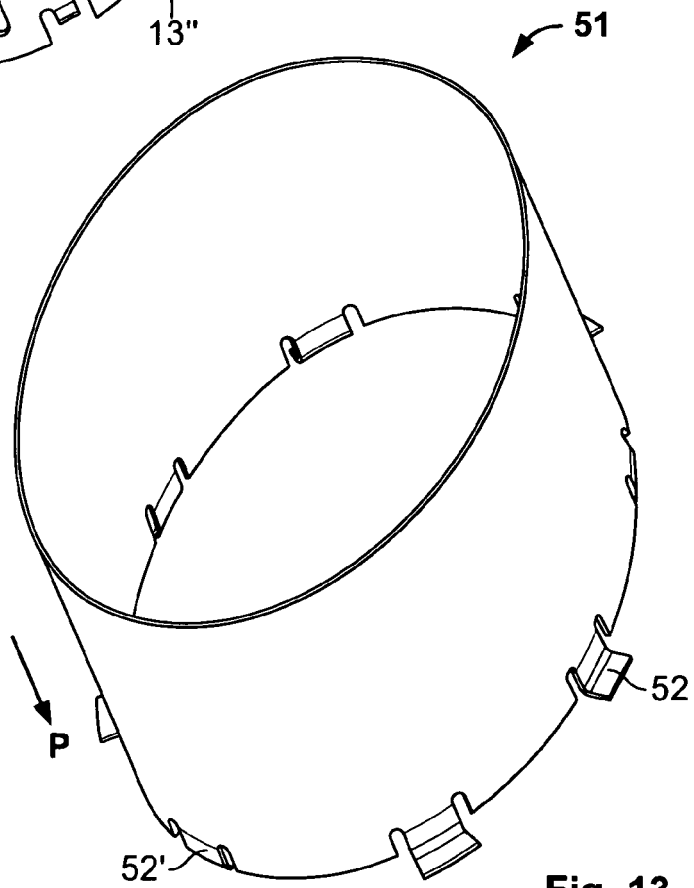


Fig. 13

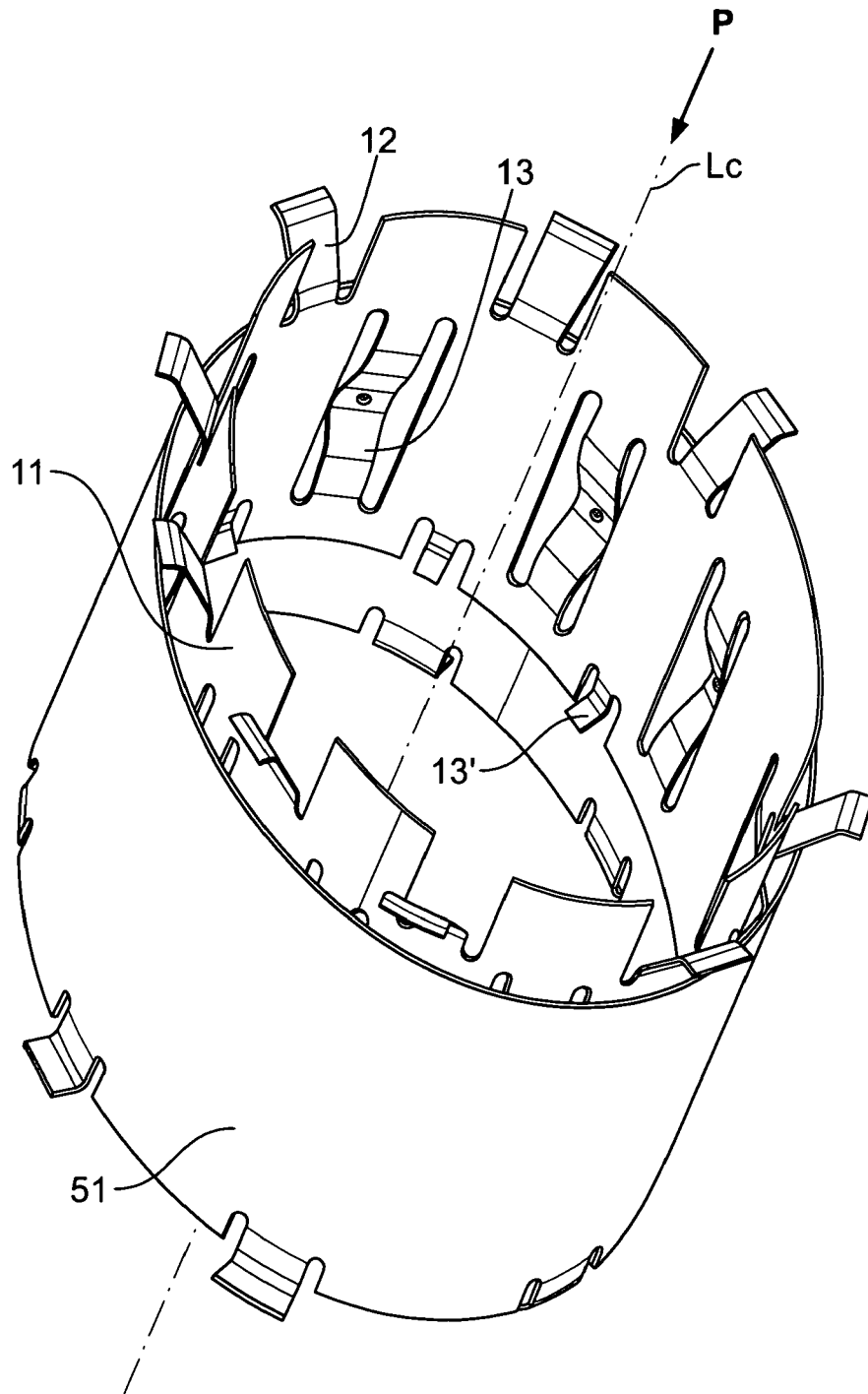


Fig. 14

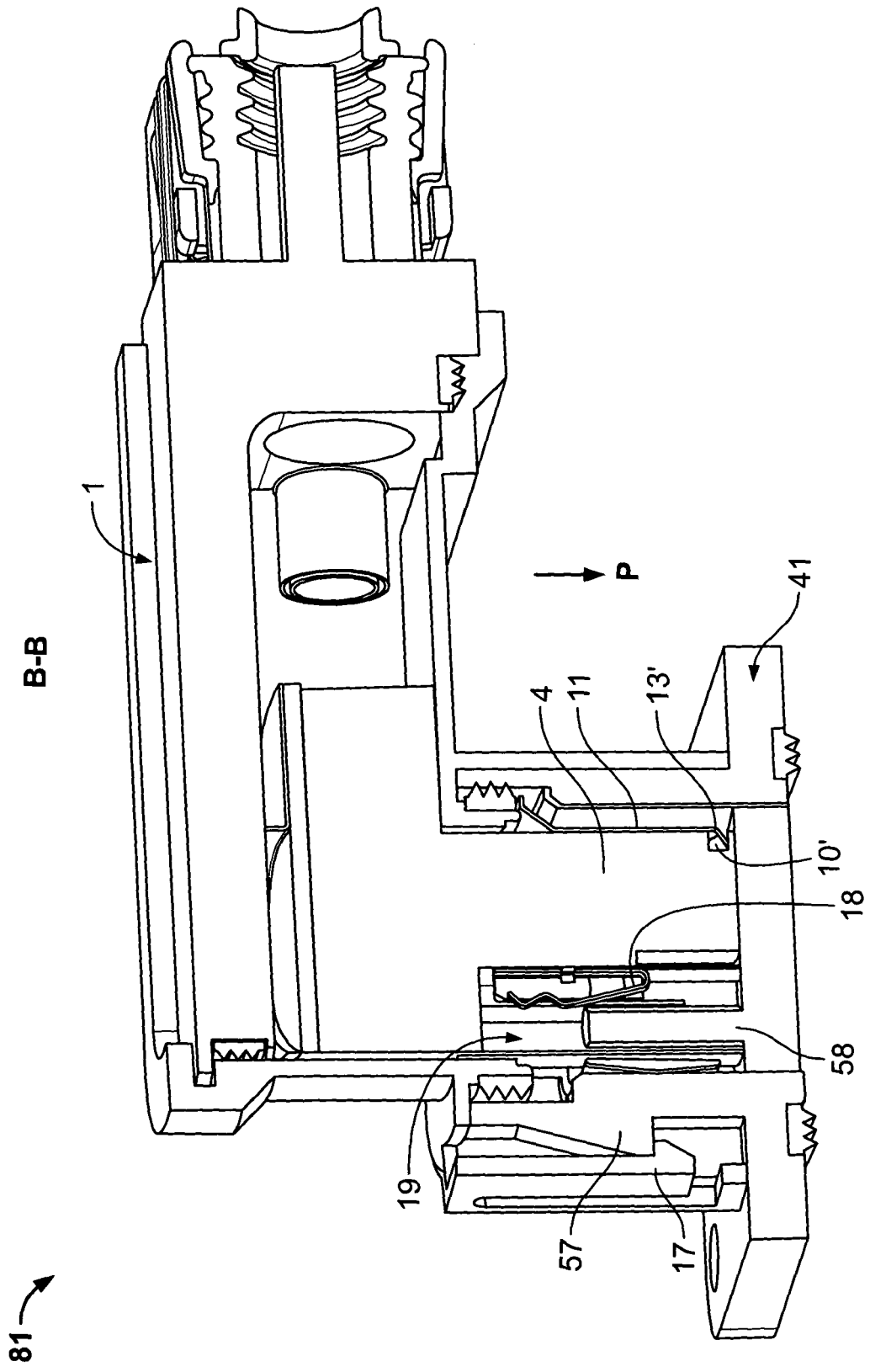


Fig. 15



EUROPEAN SEARCH REPORT

Application Number
EP 08 07 5943

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	DE 101 40 685 C1 (BALLARD POWER SYSTEMS [DE]; TYCO ELECTRONICS AMP GMBH [DE]) 27 March 2003 (2003-03-27) * claim 2 *	1-12	INV. H01R13/52 H01R13/658
X	US 2007/243730 A1 (GLADD JOSEPH H [US] ET AL GLADD JOSEPH HOWARD [US] ET AL) 18 October 2007 (2007-10-18) * figures 1,3 *	1	
X	US 2006/279937 A1 (MANSON CAREY M [US] ET AL) 14 December 2006 (2006-12-14) * claim 1 *	1	
D,A	EP 1 883 135 A (TYCO ELECTRONICS AMP ITALIA S [IT]; TYCO ELECTRONICS AMP GMBH [DE]) 30 January 2008 (2008-01-30) * abstract *	1-12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
1	Place of search The Hague	Date of completion of the search 29 May 2009	Examiner Demol, Stefan
CATEGORY OF CITED DOCUMENTS		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 08 07 5943

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29-05-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10140685	C1	27-03-2003	NONE

US 2007243730	A1	18-10-2007	NONE

US 2006279937	A1	14-12-2006	NONE

EP 1883135	A	30-01-2008	JP 2008034389 A 14-02-2008
		US 2008026639 A1	31-01-2008

EPO FORM P0459

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Patent documents cited in the description

- EP 1883135 A1 [0007]