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(54) **Electrical plug-in connector assembly with locking member**

(57) The present invention relates to an electrical plug-in connector assembly (1), in particular for establishing an electrical connection with an airbag arrangement in a vehicle, comprising a connector (2), a mating connector (3) adapted to be mated with the connector (2) along a plug direction (P), and a locking member (4) adapted to be moved in an actuation direction (A), wherein in a final state (F) of the plug-in connector assembly (1), the connector (2) is in a fully mated position (M) with the mating connector (3) and the locking member (4) is in a locking position (L) where it is supported at least at the connector (2) and secures the connector (2) and the mating connector (3) in the fully mated position (M). Further, the present invention relates to the connector (2) and the mating connector (3). In order to provide high retention forces, the present invention provides that the actuation direction (A) extends essentially perpendicularly to the plug direction (P) and in that the locking member (4) is in mesh with the mating connector (3) at least in the final state (F). The locking member (4) may provide a secondary lock independent to a primary lock for latching the connector (2) and the mating connector (3) in the fully mated position (M) and may further serve as a connector positioning assurance ("CPA").

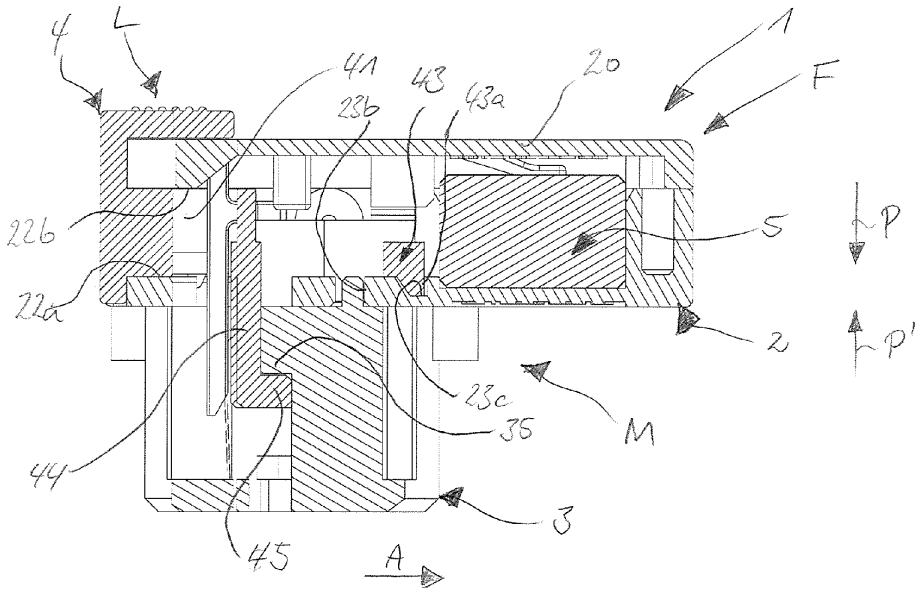

Fig. 3

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Description

[0001] The present invention relates to an electrical plug-in connector assembly, in particular for establishing an electrical connection with an airbag arrangement in a vehicle, comprising a connector, a mating connector adapted to be mated with the connector along a plug direction, and a locking member adapted to be moved in an actuation direction, wherein in a final state of the plug-in connector assembly, the connector is in a fully mated position with the mating connector and the locking member is in a locking position where it is supported at least at the connector and secures the connector and the mating connector in the fully mated position.

[0002] Further, the present invention relates to a connector for an electrical plug-in connector assembly, in particular for establishing an electrical connection with an airbag arrangement in a vehicle, the connector adapted to be mated in a plug direction with a mating connector of the plug-in connector assembly and comprising a guidance defining an actuation direction of a locking member for securing the connector in a fully mated position with the mating connector.

[0003] Moreover, the present invention relates to a mating connector for an electrical plug-in connector assembly, in particular for establishing an electrical connection with an airbag arrangement in a vehicle, the mating connector adapted to be brought into a fully mated position with a connector of the plug-in connector assembly along a mating plug direction.

[0004] Electrical plug-in connector assemblies, connectors and mating connectors of the kind mentioned above are known. The connector assemblies are used e.g. for establishing an electrical connection to an airbag arrangement in a vehicle in order to activate the squib and hence inflate the airbag in case of an emergency or accident. According to the prior art, plug-in connector assemblies are in general initially locked in the fully mated position by primary locking features between the connector and the mating connector, e.g. a pocket assembly. The primary locking feature may e.g. comprise a latch at the connector and a counter latch at the mating connector, which are brought in engagement with each other in the fully mated position. A locking member which is also referred to as a connector positioning assurance (CPA) is then commonly used to support the primary latch to increase retention force, thus ensuring that the fully mated position is reached and that the primary locking feature is secured in order to protect the plug-in connector assembly from accidental latch deflection.

[0005] A standard pocket interface for the electrical connection to a squib or gas generator in an airbag arrangement of a vehicle is defined in ISO 19072-1. According to this standard, serviceable plug-in connector assemblies comprise a separate moulded retainer which is received within the pocket to create an interface of the mating connector adapted for receiving the connector, i.e. squib connector. The pocket contains an undercut which is used for latching the retainer and the connector within the pocket. A retention force holding the retainer within the pocket and securing it against displacement opposite to the plug direction is commonly relatively low and amounts to about 10 N. The connector is directly locked at the pocket undercut with higher retention forces exerted by the primary locking feature.

[0006] However, in a majority of known connectors, the primary locking feature provides only a medium retention force of about 40 N until a secondary component, such as the locking member, is moved behind the primary lock to prevent it from deflecting and increasing the retention force to more than 120 N. To meet customer requirements for primary lock retention forces of more than 110 N need to be achieved without the use of a secondary component, e.g. the locking member.

[0007] With known connector assemblies, especially squib connectors defined according industry standard ISO 19072-1, the problem exists that it is difficult to increase the medium retention force of the primary locking feature due to the configurations of the pocket undercut. In other words, in known designs for plug-in connector assemblies, the retention force is limited.

[0008] In view of the disadvantages of plug-in connector assemblies according to the prior art mentioned above, an object underlying the invention is to provide high retention forces retaining the plug-in connector assembly in the locking position. A further object of the invention is to provide high retention forces already by a primary lock in the fully mated position.

[0009] These objects are achieved according to the invention for the electrical plug-in connector assembly mentioned in the beginning of the description in that the actuation direction extends essentially perpendicularly to the plug direction and in that the locking member is in mesh with the mating connector at least in the final state. The locking member may be in mesh with the mating connector by engaging the mating connector so that the locking member may transmit a retention force directly to the mating connector for locking the connector and the mating connector in the fully mated state.

[0010] For the connector mentioned in the beginning of the description, the problem is solved in that the actuation direction extends essentially perpendicularly to the plug direction and in that the guidance is at least partially adapted to support the locking member in a direction opposite to the plug direction.

[0011] For the mating connector mentioned in the beginning of the description, the problem is solved by a counter locking organ at least partially extending perpendicularly to the mating plug direction and facing opposite to the mating plug direction in order to support a locking organ at the mating connector for locking the connector and the mating connector in the fully mated position.

[0012] These solutions provide that a plug-in connector assembly with reduced size with respect to comparable known plug-in connector assemblies is made available which enables high retention forces. The retention

forces may exceed 120 N. No additional components other than the connector, the mating connector and the locking device are required. Thus, the cost of plug-in connector assemblies may be reduced. The locking member may additionally serve as a CPA and may be adapted to be moved into engagement with the mating connector in a direction perpendicular to the plug direction in order to prevent movements of the connector with respect to the mating connector at least against the plug direction.

[0013] Further, the inventive solution has the decisive advantage over the prior art that the locking member may provide a secondary locking function which may be realized independently of any primary locking function. Hence, the primary locking function may be designed to provide high retention forces, e.g. of more than 110 N as required by customers. The primary locking function may be realized by means such as latches, notches, noses, detents, catches and/or stops, which do not interfere with the locking member and/or do not rely thereon for achieving a desired high retention force.

[0014] The solutions according to the invention can be combined as desired and further improved by the following further embodiments that are advantageous on their own in each case:

According to a first further embodiment of a plug-in connector assembly according to the present invention, a locking element of the locking member may be arranged behind the counter locking element of the mating connector in the plug direction. The locking element may latch behind the counter locking element. An interlocking of the connector and the mating connector may be provided by the locking member. Hence, the locking member may interleave and/or engage with the connector and the mating connector in order to interlock them in their fully mated position.

[0015] The locking element may at least partially be formed as a sliding bolt and the counter locking element may at least partially be formed as a lug interleaving with the locking element in a projection along the plug direction. Thereby, the locking element may be easily brought into engagement with the counter locking element by sliding the locking member in the actuation direction.

[0016] The locking member may comprise a blocking organ and the connector may comprise a stop, wherein in a pre-mated position of the connector and the mating connector, an actuation of the locking member may be limited at the stop by the blocking organ. Thereby, the locking member may signalize that the connector and the mating connector are not properly mated in the fully mated position. A premature actuation of the locking member may be prevented. The stop may prevent the locking member from being transferred from a release position or pre-locking position to the locking position in the pre-mated position. In other words, a movement of the locking member may be blocked in a pre-mated position of the plug-in connector assembly, i.e. before the connector and the mating connector have reached their fully mated position.

[0017] In the fully mated position, a de-blocking organ of the mating connector may release the blocking organ from the stop so that the locking member is transferable from the pre-locking position into the locking position. Thereby, it may be easily indicated that the connector and the mating connector are in the fully mated position.

[0018] In the locking position, a catch formed at the blocking organ may be in engagement with a counter catch of the connector, so that the locking member is latched at the connector in the locking position. Thereby, the locking member may be secured in the locking position. The latching interaction between the catch and the counter catch may signalize, e.g. by an audible clicking sound, that the locking member has properly reached the locking position.

[0019] The mating connector may comprise a retainer providing a counter latching element and the connector may comprise a latching element, wherein in the fully mated position, the latching element and the counter latching element may prevent movements of the connector with respect to the mating connector at least opposite to the plug direction. The latching element and the counter latching element may serve as a primary lock. The locking member may provide the secondary lock. Hence, the primary and the secondary lock may provide redundancy in locking the connector and the mating connector in the fully mated position. The locking member may additionally close any access to the primary lock, at least when the locking member is in the locking position.

[0020] The at least one counter latching element may be formed as a nose extending from a mating plug portion of the mating connector essentially radially away from a middle axis of the plug-in connector assembly. Hence, the connector may be latched with the mating connector directly in a way that is also referred to as an inertia-type locking. A high force is required to overcome latch deflection in a so called inertia type locking. An inertia of this force after latch deflection helps to ensure full mating. In any way, due to forming the latching element as said nose, high retention forces and snap-in signalization of the latching element and the counter latching element in the fully mated position may be provided. Further, the retainer of the mating connector may provide a cavity for at least partially receiving a header shroud or plug portion of the connector. The latching element may protrude laterally into said cavity. Thereby, the connector may be directly latched at the retainer instead of the pocket in order to avoid restrictions in supporting the connector at the pocket undercut.

[0021] The latching element and the counter latching element may be at least a part of a primary lock and the locking member may at least be a part of a secondary lock, wherein the primary lock and the secondary lock independently of each other may lock the connector and the mating connector in the fully mated position. Hence,

the primary lock, which may comprise or be constituted by at least one latching element and a corresponding counter latching element, may be designed to provide high retention forces of above 110 N independently of the secondary lock.

[0022] A movement of the locking member in the actuation direction may be blocked at the latching element and/or the counter latching element in a pre-mated position of the connector. For example, in the pre-mated position, the latching element may be deflected so that it is in the way of the locking member. In the locking position, the locking member may serve as a CPA in that inhibits deflection of the latching element and secures the latching element and/or primary lock.

[0023] The locking member may at least restrict an access to the latching element and/or the counter latching element from outside the plug-in connector assembly in the final state. Thereby, the locking member may prevent that the latching element is deflected and/or the primary lock is opened when the locking member is in the locking position. Thus, the locking member may prevent inadvertently, accidentally and/or inappropriately disconnecting the connector and the mating connector.

[0024] In a further embodiment of a connector according to the present invention, the connector may comprise a housing which may be provided with an opening to said guidance wherein the opening is arranged laterally at the housing and faces into a direction essentially perpendicular to the plug direction. Thereby, the locking member may be easily inserted into the connector and actuated in that it may protrude laterally from the opening in the pre-locking position in order to be brought into alignment with a lateral face of the connector when reaching the locking position by being pushed in the actuating direction.

[0025] The guidance may be provided with a stop facing opposite to the actuation direction, so that in a pre-mated position of the connector, movements of the locking member in the actuation direction may be limited at the stop. Thereby, the locking member may be prevented from accidentally assuming the locking position before the connector and the mating connector are in their fully mated position. The locking member can thus be used as an indicator for indicating whether the connector and the mating connector are in a pre-mated position or in the fully mated position.

[0026] In a further embodiment of a mating connector according to the present invention, a de-blocking organ may at least partially protrude from the mating connector in the mating plug direction and may be adapted to release a blocking organ of a locking member for securing the connector and the mating connector in the fully mated position. The de-blocking organ may be formed as a stud protruding from the mating connector in the mating plug direction in order to lift the blocking organ from a stop formed at the connector when reaching the fully mated position.

[0027] The mating connector may comprise a mating plug portion provided with a counter latching element adapted to engage a latching element of the connector in order to prevent movements of the mating connector with respect to the connector at least against the mating plug direction. The counter latching element may be formed as a latching nose and the latching element as a latching tongue with an opening or recess for engaging the latching element in a positive-fit manner. Thereby, an inertia-type primary locking feature may be provided which may serve for indicating that the connector and the mating connector have reached the fully mated position by generating an audible clicking sound for example and providing high retention forces keeping the connector and the mating connector in the fully mated position.

[0028] A cavity for at least partially receiving a header shroud or plug portion of the connector may be formed between the counter latching element and a wall of the mating connector. Hence, the primary latching function of the plug-in connector assembly may be arranged within the connector, i.e. in the cavity accommodating the plug portion. Thereby, the primary locking feature may be protected against detrimental environmental influences and protected within the plug-in connector assembly.

[0029] The mating connector may comprise a retainer accommodating a pocket of the mating connector, wherein the counter locking element is formed at the retainer. The pocket may be formed according to the respective industry standard for the mating connector. The retainer may be formed and adapted according to the respective requirements to the plug-in connector assembly. The retainer may comprise all elements for essentially locking and latching the connector and the mating connector in the fully mated position. In other words, the retainer may comprise the respective features for realizing a primary and secondary locking function.

[0030] The retainer may be provided with at least one fixation member and the pocket may be provided with at least one counter fixation member, wherein in an assembled state of the mating connector, the fixation member may be in engagement with the counter fixation member so that the retainer is locked within the pocket. Thereby, movements of the retainer in the mating plug direction, i.e. towards the connector, are prevented. The fixation member may be formed as a locking latch interacting with the counter fixation member which may be formed as a groove or recess, e.g. as an undercut of the pocket. When the fixation member is in engagement with the counter fixation member, the retainer may be held within the pocket with a retention force of more than 120 N in order to meet respective safety requirements. Alternatively, the retainer and the pocket may be integrally formed as one piece, e.g. by casting, moulding, etc.

[0031] The invention will be described in more detail by way of example hereinafter using advantageous embodiments and with reference to the accompanying 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 description relating to equal elements illustrated in different drawings are left out.

[0032] In the drawings:

Fig. 1 is a schematic perspective cross-sectional view of a plug-in connector assembly according to an embodiment of the present invention, comprising a connector and a mating connector in a pre-mated position and a locking member blocked in a pre-locking position;

Fig. 2 is a schematic cross-sectional view of the plug-in connector assembly shown in Fig. 1 with the connector and the mating connector in the fully mated position and the locking member released in the pre-locking position;

Fig. 3 is a schematic cross-sectional view of the plug-in connector assembly shown in Figs. 1 and 2 in the final state, wherein the connector and the mating connector are in the fully mated position and the locking member is in the locking position;

Fig. 4 is a schematic cross-sectional view the plug-in connector assembly of Figs. 1 to 3 in the final state with the primary locking feature engaged:

Fig. 5 is a schematic perspective view of a mating connector comprising a pocket accommodating a retainer according to an embodiment of the present invention;

Fig. 6 is a schematic perspective view of the retainer of the mating connector shown in Fig. 5;

Fig. 7 is a schematic top view of the retainer illustrated in Fig. 6;

Fig. 8 is a schematic cross-sectional view of the mating connector shown in Fig. 5;

Fig. 9 is a schematic cross-sectional view of another embodiment of a plug-in connector assembly according to the present invention in the final state;

Fig. 10 is a schematic perspective cross-sectional view of the plug-in connector assembly shown in Fig. 5;

Fig. 11 is schematic perspective view of a plug-in connector assembly according to the prior art;

Fig. 12 is a schematic cross-sectional view of the plug-in connector assembly according to the prior art shown in Fig. 9 with a connector and a mating connector according to the prior art in the fully mated position and a locking member according to the prior art in the pre-locking position;

Fig. 13 is a schematic cross-sectional view of the plug-in connector assembly shown in Figs. 9 and 10 in the final state, wherein the connector and the mating connector according to the prior art are in the fully mated position and the locking member according to the prior art is in a locking position; and

Fig. 14 is a schematic perspective view of a retainer of the mating connector according to the prior art shown in Figs. 9 to 11.

[0033] An exemplary construction of a plug-in connector assembly 1 according to the present invention will first be described in the following with reference to Fig. 1, which shows a schematic cross-sectional view of the plug-in connector assembly 1. The plug-in connector assembly 1 comprises a connector 2, a mating connector 3 and a locking member 4. The plug-in connector assembly 1 may be used for electrically connecting and/or accommodating an electrical component 5 of e.g. a filter of an airbag arrangement in a vehicle. The electrical component 5 may be received within the connector 2.

[0034] The connector 2 has a housing 20 providing an interior 21 for accommodating electrical conductors, i.e. terminals and electrical lines, as well as other functional elements and the electrical component 5. An opening 22 to the interior 21 is formed laterally at the housing 20 and provides guidances 22a, 22b defining an actuation direction A for the locking member 4. A blocking organ 23 is formed at the housing 20. The blocking organ 23 is provided with a blocking recess 23a providing a stop 23b for limiting movements of the locking member 4 in the actuation direction A in the pre-mated position of the connector 2 and the mating connector 3 illustrated in Fig. 1. The blocking organ 23 further provides a catch in the form of a notch in the wall of the housing 20 for latching the locking member in a locking position L (not yet shown).

[0035] A plug portion 24 of the connector 2 protrudes from the housing 20 in a plug direction P of the connector 2, in which the connector 2 is adapted to be mated with the mating connector 3. A latching element 25 of the connector 2 may be formed as a part of the plug portion 24 so that it protrudes from the housing 20 in the plug direction P in order to latch the connector 2 and the mating connector 3 in a fully mated position M (not yet shown).

[0036] The mating connector 3 comprises a retainer 30 which is accommodated in a pocket 31 formed by a casing 32. A mating plug portion 33 of the mating connector 3 is arranged within the pocket 31 so that a cavity

34 between the casing 32 and the mating plug portion 33 is provided for at least partially accommodating the plug portion 24 of the connector 2. A counter locking organ 35 is formed at the mating plug portion 33 for locking the connector 2 and the mating connector 3 in the fully mated state M (not yet shown). The counter locking organ 35 is formed as a lug laterally protruding from the mating plug portion 33 opposite to the actuation direction A. Further, a de-blocking organ 36 is arranged at the mating plug portion 33 and protrudes from the mating connector 3 in the mating plug direction P'. The de-blocking organ 36 is formed as a stud protruding towards the blocking organ 23.

[0037] The locking member 4 has a body 40 which is guided and supported by the guidances 22a, 22b of the connector 2 so that it juts into the interior 21 of the housing 20 of the connector 2. In particular, a shaft 41 of the locking member 4 is halfway inserted into the housing 20 in the pre-locking position K of the locking member 4 illustrated in Fig. 1. An actuating section 42 is formed at an end of the shaft 41 so that the locking member 4 may be manually actuated from outside the connector 2. A lateral face 42a of the actuating section 42 faces opposite to the actuating direction A so that the locking member 4 may be actuated by exerting a pressure onto the lateral face 42a in the actuating direction A. A cover section 42b extends laterally from the actuating section, in particular from the lateral face 42 so that the cover section 42b juts above and beyond the housing 20 in the mating plug direction P'. A ribbing 42c is formed at a top 42d of the guiding section 42b in order to enhance a grip for actuating the locking member 4.

[0038] A resiliently deflectable blocking organ 43 of the locking member 4 is mechanically connected to or formed at the shaft 41 and arranged within the interior 21 of the housing 20 of the connector 2. A catch 43a juts into the blocking recess 23a in the pre-locking position K as long as the connector 2 and the mating connector 3 are in the pre-mated position M. Hence, the locking member 4 is blocked in the pre-locking position K by the catch 43a engaging the blocking recess 23a so that the catch 43a abuts the stop 23b of the blocking organ 23. A vertical extension 44 of the blocking member 4 juts beneath the housing 20 of the connector 2 and is aligned with the plug portion 24. A locking organ 45 protrudes from the vertical extension 44 in the actuation direction A and is adapted for interacting with the counter locking organ 35 formed at the mating connector 3.

[0039] Fig. 2 shows the plug-in connector assembly 1 in the fully mated state M, where the connector 2 and the mating connector 3 are fully mated, i.e. the plug portion 24 of the connector 2 is fully inserted into the cavity 34 of the mating connector 3 such that the plug portion 24 complements the mating plug portion 33. The de-blocking organ 36 juts through the blocking recess 23a and thereby lifts the blocking organ 43 above and beyond the blocking organ 23 so that the locking member 4 is released and may be moved in the actuation direction A by sliding the shaft 41 along the guidances 22a, 22b.

[0040] Fig. 3 shows the plug-in connector assembly 1 in a final state F, wherein the connector 2 and the mating connector 3 are in the fully mated position M and the locking member 4 is in a locking position L. In the locking position L, the locking organ 45 on the locking member 4 is in mesh with the counter locking organ 35 on the mating connector 3. The locking organ 45 is arranged behind the counter locking organ 35 in the plug direction P so that forces acting on the connector 2 opposite to the plug direction P are transmitted via the shaft 41 of the locking member 4 supported at the bottom guidance 22a and via the vertical extension 44 to the locking organ 45 from where these forces are transferred to the counter locking element 35 so that the locking member 4 locks the connector 2 to the mating connector 3 in the locked position L.

[0041] Further, the blocking organ 43 is moved beyond the stop 23 in the actuation direction A. The catch 43a on the blocking organ 43 is in engagement with a counter catch 23c formed at the inner circumference of the wall of the housing 20. The catch 43a is formed as a nose protruding from the blocking organ 43 in the plug direction P into the counter catch 23c formed as a cavity or recess. Thereby, the locking member 4 is additionally supported at the connector 2 in order to take up forces attempting to withdraw the connector 2 from the mating connector 3 against the plug direction P. Through the engagement of the blocking organ 43 and the counter catch 23c, the locking member 4 is secured in the locking position L against displacement opposite to the actuation direction A.

[0042] Fig. 4 illustrates the plug-in connector assembly 1 in the final state in another schematic cross-sectional view along a central axis C extending in parallel to the plug direction P centrally through the plug portion 24 and the mating plug portion 33. Here it becomes apparent that in the fully mated position M of the connector 2 and the mating connector 3, the latching element 25 of the connector 2 is engagement with a counter latching element 35a formed at the mating plug portion 33. The latching element 25 has the form of a latching tongue provided with a latching recess 25a. Thereby, the latching element 25 and the counter latching element 35a provide a primary locking function for latching the connector 2 to the mating connector 3 in the fully mated position M.

[0043] A bottom 42e is formed at the locking member 4. The bottom 42e is designed as a supporting section extending transversely to the shaft 41 so that the bottom 42e connects the shaft 41 to the lateral face 42a like a cross beam. A front face 42f of the locking member 4 is formed at the bottom and faces into the actuation direction A. The front face 42f is arranged so that in the pre-mated position M, movements of the locking member 4 in the actuation direction A are blocked at the connector 2, in particular at the latching element 25. In other words, the front face 42f may act as an additional blocking member and the latching element 25 may act as an additional

stop for blocking the locking member 4 in the pre-mated position M. The blocking may be achieved in that in the pre-mated position M, the latching element 25 may be deflected towards the front face 42f, i.e. opposite to the actuation direction A. Thereby, the latch 25 can be in the way of the front face 22f when moving the locking member 4 in the actuation direction A. Hence, premature locking, i.e. moving the locking member 4 in the locking position L may be prevented in the pre-mated position M.

[0044] When a connector 2 and the mating connector 3 are in the fully mated position M, the latch 25 and/or other sections of the connector 2 are moved out of the front face 42f so that the locking member 4 may be moved into the locking position L. In the locking position L the front face 42f may abut the latching element 25 or at least may be arranged in the vicinity of the latching element 25 so that deflecting the latching element 25 is prevented or at least inhibited. This helps in securing the latching element 25 in the fully mated position M and thereby increasing retention forces between the connector 2 and the mating connector 3. In the final state F shown in Fig. 4, the locking member 4, in particular the top 42d of the locking member 4 overlaps with the latching element 25 of the connector 2 at least in the plug direction P. The top 42d closes an access to the cavity 34, where the latching element 25 is arranged. Hence, an access to the latching element 25 is prevented by the locking member 4, when the locking member 4 is in the locking position L. Further, two recesses 26a and 26b are formed in the bottom guidance 22a. A detent 46 is formed at the bottom 42e of the locking member 4 and is latched in the second recess 26b so that the locking member 4 is additionally latched at the connector 2 in the locked position L. The first recess 26a allows for latching the locking member 4 at the connector 2 in the pre-locking position K, so that the locking member 4 may be held captive at the connector 2.

[0045] Fig. 5 is a schematic perspective view of the mating connector 3 in an assembled state S where the retainer 30 is fixed within the pocket 31. Two fixation members 37 are formed at the retainer 30 and are in engagement with a counter fixation member 38 are formed at the pocket as an undercut. Each of the fixation elements 37 is provided with polarizing elements 37a and 37b in the form of webs extending essentially in parallel to the mating plug direction P' along the fixation members 37. The polarizing elements 37a, 37b are arranged within counter polarizing elements 38a and 38b, respectively, which are formed as grooves extending in parallel to the mating plug direction P' at the inner circumference of the pocket 31. The fixation members 37 extend from a base 39 of the retainer. The base 39 connects the fixation elements 37 to the mating plug portion 33. Two contact receptacles 33a, 33b are formed in the mating plug portion 33 and each accommodate a contact element 6, i.e. an electrical conductor of the mating plug element 3.

[0046] Fig. 6 shows the retainer 30 in a schematic perspective view in a pre-assembled state R of the mating plug connector 3. Here, the retainer 30 is withdrawn from the pocket 31. Two of the fixation members 37 are provided with a latch 37c each, adapted to engage with the counter fixation member 38 in the form of a circumferential groove in order to affix the retainer 30 within the pocket 31.

[0047] Fig. 7 shows the retainer 30 in a schematic top view. Here it becomes apparent that the latches 37c on the fixation members 37 radially protrude beyond the outer circumference of the base 39 and are arranged symmetrically to each other with respect to the central axis C. The polarizing elements 37a and 37b also radially protrude beyond the outer circumference of the base 39. However, in contrast to the latches 37c, the polarizing elements 37a and 37b are arranged asymmetrically to each other with respect to the central axis C in order to define one single angle of rotation under which the retainer 30 is to be introduced into the pocket 31.

[0048] Fig. 8 shows the mating connector 3 in the assembled state S, where the retainer 30 is inserted into the pocket 31 and the fixation members 37 on the retainer 30 are in engagement with the counter fixation members 38 within the pocket 31. The latches 37c on the fixation members protrude radially into the counter fixation member 38 which is formed as a groove extending along the inner circumference of the pocket 31. Thereby, the fixation members 37 and the counter fixation members 38 are in engagement with each other in a positive-fit manner. Tips of the fixation members 37, in particular of the latches 37c, are arranged below respective edges of the groove forming the counter fixation member 38 so that the retainer 30 is supported in the pocket in a robust way in the mating plug direction P'.

[0049] Fig. 9 is a schematic cross-sectional view along the central axis C of another embodiment of a plug-in connector assembly 1' according to the present invention in the final state F. The plug-in connector assembly 1' comprises a connector 2', a mating connector 3' and a locking member 4' which are formed and function similar to those of the embodiment of the plug-in connector assembly 1 described above. For the sake of brevity, only the differences between the plug-in connector assembly 1 and the plug-in connector assembly 1' will be explained in the following. Identical or similar elements which may have identical or similar functions in both embodiments of the plug-in connector assembly 1, 1' will in the following be denoted with the same reference numeral provided with an apostrophe.

[0050] In the final state F of the plug-in connector assembly 1', the mating connector 3' is in the assembled state S, the connector 2' and the mating connector 3' are in the fully mated position F' and the locking member 4' is in the locking position L. Latching elements 25' of the connector 2' provide a latching recess 25a' each which engage with a counter latching element 35a' of a retainer 30' of the mating connector 3' each. The latching elements 25' and counter latching elements 35a' may be arranged symmetrically to each other with respect to the

central axis C. They may be arranged so that they do not interfere with fixation members 37' of the retainer 30' which provide latches 37c engaging the counter fixation member 38. By providing the latching elements 25', or in particular two latching elements 25' as shown herein, the retention forces of a primary lock of the plug-in connector assembly 1' may be enhanced, e.g. essentially doubled with respect to the retention forces of the plug-in connector assembly 1. Other functions of the plug-in connector assembly 1', i.e. blocking and secondary locking functions of the locking member 4' remain the same as those of the locking member 4.

[0051] Fig. 10 is a schematic cross-sectional perspective view of the plug-in connector assembly 1' in the final state F. Here it becomes apparent that the locking member 4' may comprise several shafts 41' which extend essentially in parallel to the actuation direction A. The shafts 41' may serve for carrying counter locking organs 35' (not shown) of the locking member 4' for locking the connector 2' to the mating connector 3', e.g. as secondary locking elements. The shafts 41' may further serve for supporting the latches 25' in the fully mated position M so that they are prevented from deflection. Moreover, the shafts 41' may provide blocking organs 43' (not shown) for blocking the locking member 4' in the pre-locking position K, before the connector 2' and the mating connector 3' are in the fully mated position M. Fig. 11 is a schematic perspective view of a plug-in connector assembly 100 according to the prior art. The plug-in connector assembly 100 comprises a connector 102, a mating connector 103 and a locking member 104. In the final state F' of the plug-in connector assembly 100 according to the prior art, the connector 102 and the mating connector 103 are in the fully mated state M' and the locking member 104 is in the locked position L'.

[0052] Fig. 12 is schematic cross-sectional view of the plug-in connector assembly 100 according to the prior art along a central axis C' of the plug-in connector assembly 100. The connector 102 and the mating connector 103 are in the fully mated state M', where a plug portion 124 of the connector 102 is inserted into a mating plug portion 133 of the mating connector 103 in order to contact the contact elements 106 of the plug-in connector assembly 100 in an electrically conductive manner.

[0053] In the fully mated state M', the connector 102 is in engagement with a pocket 131 of the mating connector 103. In particular, latching elements 125 on the connector 102 radially protrude therefrom into a counter fixation member 138 formed as a groove extending along the inner circumference of the pocket 131. Thereby, the connector 102 is directly latched to the pocket 131, while a retainer 130 of the mating connector 103 is independently fixed within the pocket 131. Further, in a pre-locking position K', the locking member 104 juts into the connector 102 through respective openings 122 formed in a housing 102 of the connector 2 into an interior 121 of the housing 120.

[0054] Fig. 13 shows the plug-in connector assembly 100 according to the prior art in schematic cross-sectional view along the central axis C' in the final state F'. Here, the connector 102 and the mating connector 103 are in the fully mated state M'. The locking member 104 is moved downwards along the plug direction P' until reaching the locking position L'. In the locking position L' of the locking member 104, the shafts 141 of the locking member 104 are arranged snugly between the mating plug portion 133 and the latching elements 125 so that the latching elements 125 are supported laterally and prevented from being deflected radially towards the central axis C' and thereby withdrawn from the counter fixation members 138. In other words, the shafts 141 block the latching elements 125 in order to prevent disengagement of the latching elements 125 and the counter fixation members 138.

[0055] Fig. 14 is a schematic perspective view of the retainer 130 of a plug-in connector assembly 100 according to the prior art in a pre-assembled state R', where the retainer 130 is withdrawn from the pocket 131. Here it becomes apparent that the retainer 130 is merely provided with fixation members 137 in the form of small bosses slightly protruding laterally from an outer circumference of the retainer in order to engage with the counter fixation elements 138 within the pocket 131 so that the retainer is prevented from falling out of the pocket 138 in the mating plug direction P'. However, in contrast to the fixation members 38 according to the present invention, the fixation members 138 according to the prior art do not allow for generating retention forces acting opposite to the mating plug direction P' which are bigger than 120 N.

[0056] Deviations from the above-described embodiments of a plug-in connector assembly 1 according to the present invention are possible without departing from the scope of the invention. The connector 2 may be provided with a housing 20 having an interior 21 which may be formed as required for accommodating the locking member 4, electrical components 5, contact elements 6 and may have a plug portion 24 formed as required for complementing a mating plug portion 33 of the mating connector 3. The connector 2 and the mating connector 3 may be provided with contact elements 6 in whatever form and number required for establishing a desired electrical connection. Guidances 22, shafts 41, blocking organs 23, blocking recesses 23a, stops 23b, latching elements 25, counter catches 23c, latching recesses 25a, cavities 34, counter locking organs 35, de-blocking organs 36, fixation members 37, counter fixation members 38, actuating sections 42, lateral faces 42a, cover sections 42b, ribbings 42c, tops 42d, bottom 42e, blocking organs 43, catches 43a, vertical extensions 44, locking organs 45, detents 46, first and second recesses 26a, 26b, contact receptacles 33a, polarizing elements 37a, 37b, counter polarizing elements 38a, 38b, recesses 39a and latches 37c may be provided in any form and number desired for fulfilling their respective function. The housing 20 may comprise one or more components, e.g. shells

or casing parts.

[0057] The locking member 4, 4' may have several functions. A first function may be to signalize the pre-mated position N in that the locking member 4, 4' and/or front face 42f prevent movement of the locking member 4 to the locking position L. A second function of the locking member 4, 4' may be that it prevents deflection of the latch 25, 25' in the fully mated position M, i.e. the locking member 4, 4' may act as a CPA securing the correct position of the plug-in connector assembly 1 in the fully mated position M and may secure the latching element 25, 25' acting as a primary lock. A third function of the locking member may be to directly lock the connector 2, 2' to the mating connector 3, 3' by the locking organ 45 serving as a secondary locking element, e.g. when a first locking element, such as the latching element 25, 25' is at hand. A fourth function of the locking member 4, 4' may be to close an access to the latching element 25 in the fully mated position M, i.e. to prevent accessing any latch release area which may be located in a cavity 34.

Claims

1. Electrical plug-in connector assembly (1), comprising a connector (2), a mating connector (3) adapted to be mated with the connector (2) along a plug direction (P), and a locking member (4) adapted to be moved in an actuation direction (A), wherein in a final state (F) of the plug-in connector assembly (1), the connector (2) is in a fully mated position (M) with the mating connector (3) and the locking member (4) is in a locking position (L) where it is supported at least at the connector (2) and secures the connector (2) and the mating connector (3) in the fully mated position (M), **characterised in that** the actuation direction (A) extends essentially perpendicularly to the plug direction (P) and **in that** the locking member (4) is in mesh with the mating connector (3) at least in the final state (F).

2. Plug-in connector assembly (1) according to claim 1, **characterised in that** a locking organ (45) of the locking member (4) is arranged behind a counter locking organ (35) of the mating connector (3) in the plug direction (P).

3. Plug-in connector assembly (1) according to claim 2, **characterised in that** the locking element (45) is at least partially formed as a sliding bolt and the counter locking organ (35) is at least partially formed as a lug interleaving with the locking organ (45) in a projection along the plug direction (P).

4. Plug-in connector assembly (1) according to at least of claims 1 to 3, **characterised in that** the locking member (4) comprises a blocking organ (43) and the connector (2) comprises a stop (23b), wherein in a pre-mated position (N) of the connector (2) and the mating connector (3), an actuation of the locking member (4) is limited at the stop (23c) by the blocking organ (43).

5. Plug-in connector assembly (1) according to claim 4, **characterised in that** in the fully mated position (M), a de-blocking organ (36) of the mating connector (3) releases the blocking organ (43) from the stop (23b) so that the locking member (4) is transferrable from a pre-locking position (K) into the locking position (L).

6. Plug-in connector assembly (1) according to claim 4 or 5, **characterised in that** in the locking position (L) a catch (43a) formed at the blocking organ (43) is in engagement with a counter catch (23c) of the connector (2), so that the locking member (4) is latched at the connector (2) in the locking position (L).

7. Plug-in connector assembly (1) according to at least one of claims 1 to 6, **characterised in that** the mating connector (3) comprises a retainer (30) providing a counter latching element (35a) and the connector (2) comprises a latching element (25), wherein in the fully mated position (M), the latching element (25) and the counter latching element (35a) prevent movements of the connector (2) with respect to the mating connector at least against the plug direction (P).

8. Plug-in connector assembly (1) according to claim 7, **characterised in that** the at least one counter latching element (35a) is formed as a nose extending from a mating plug portion (33) of the mating connector (3) essentially radially away from a central axis (C) of the plug-in connector assembly (1).

9. Plug-in connector assembly (1) according to claim 7 or 8, **characterised in that** the latching element (25) and the counter latching element (35a) are at least a part of a primary lock, and **in that** the locking member (4) is at least a part of a secondary lock, wherein the primary lock and the secondary lock independently of each other lock the connector (2) and the mating connector (3) in the fully mated position (M).

10. Plug-in connector assembly (1) according to at least one of claims 7 to 9, **characterised in that** a movement of the locking member (4) in the actuation direction (A) is blocked at the latching element (25) and/or the counter latching element (35a) in a pre-mated position (N) of the connector (2).

11. Plug-in connector assembly (1) according to at least one of claims 7 to 10, **characterised in that** the locking member (4) at least restricts an access to the

latching element (25) and/or the counter latching element (35a) from outside the plug-in connector assembly (1) in the final state (F).

12. Connector (2) for an electrical plug-in connector assembly (1), the connector (2) adapted to be mated in a plug direction (P) with a mating connector (3) of the plug-in connector assembly (1) and comprising a guidance (22a, 22b) defining an actuation direction (A) of a locking member (4) for securing the connector (2) in a fully mated position (M) with the mating connector (3), **characterised in that** the actuation direction (A) extends essentially perpendicularly to the plug direction (P) and **in that** the guidance (22a, 22b) is at least partially adapted to support the locking member (4) in a direction opposite to the plug direction (P).

13. Connector (2) according to claim 12, **characterised in that** the connector (2) comprises a housing (20) which is provided with an opening (22) to said guidance (22a, 22b), wherein the opening (22) is arranged laterally at the housing (20) and faces into a direction essentially perpendicular to the plug direction (P).

14. Connector (2) according to claim 12 or 13, **characterised in that** the guidance (22a, 22b) is provided with a stop (23b) facing opposite to the actuation direction (A), so that in a pre-mated position (N) of the connector (2), movements of the locking member (4) in the actuation direction (A) are limited at the stop (23b).

15. Mating connector (3) for an electrical plug-in connector assembly (1), the mating connector (3) adapted to be brought into a fully mated position (M) with a connector (2) of the plug-in connector assembly (1) along a mating plug direction (P'), **characterised by** a counter locking organ (35) at least partially extending perpendicularly to the mating plug direction (P') and facing opposite to the mating plug direction (P') in order to support a locking organ (45) at the mating connector (3) for locking the connector (2) and the mating connector (3) in the fully mated position (M).

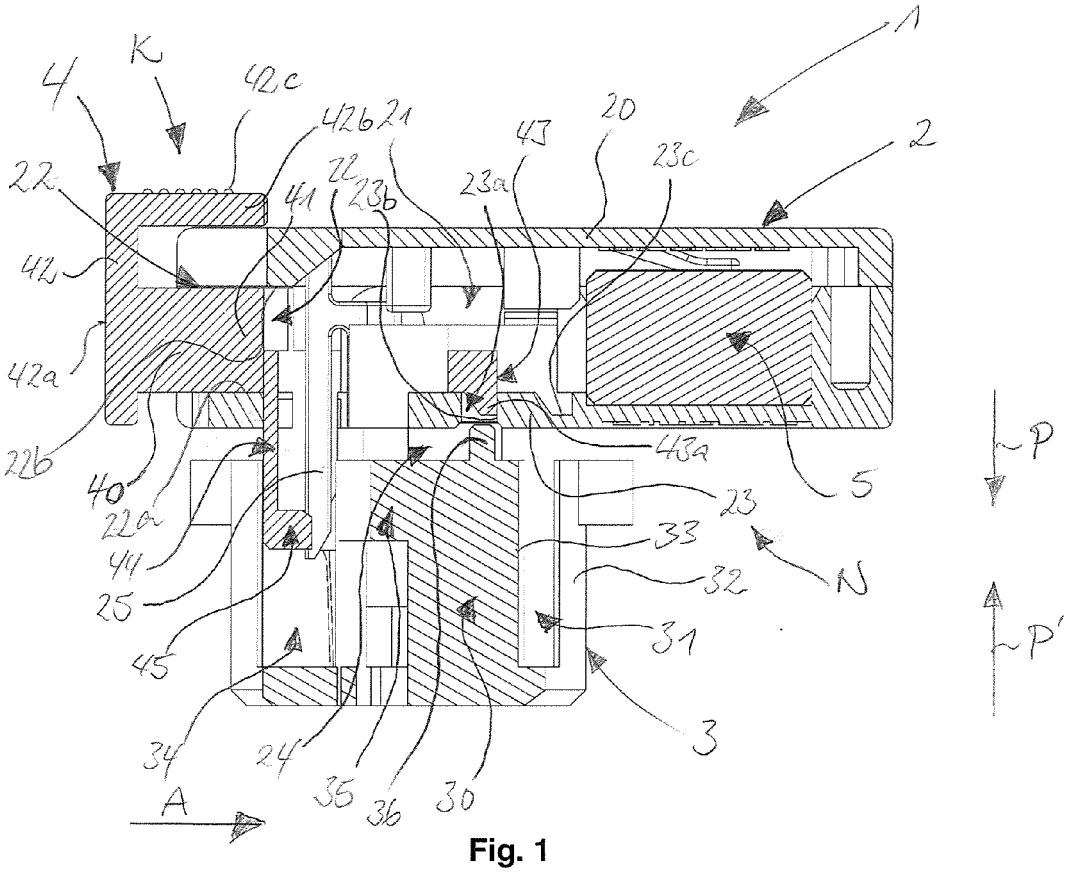
16. Mating connector (3) according to claim 15, **characterised by** a de-blocking organ (36) at least partially protruding from the mating connector (3) in the mating plug direction (P') and adapted to release a blocking organ (23) of a locking member (4) for securing the connector (2) and the mating connector (3) in the fully mated position (M).

17. Mating connector (3) according to claim 15 or 16, **characterised in that** the mating connector (3) comprises a mating plug portion (33) provided with a counter latching element (35a) adapted to engage a latching element (25) of the connector (2) in order to prevent movements of the mating connector (3) with respect to the connector (2) at least opposite to the mating plug direction (P').

18. Mating connector (3) according to claim 17, **characterised in that** a cavity (34) for at least partially receiving a plug portion of the connector (2) is formed between the counter latching element (35a) and a wall of the mating connector (3).

19. Mating connector (3) according to claim at least one of claims 15 to 18, **characterised in that** the mating connector (3) comprises a retainer (30) accommodated in a pocket (31) of the mating connector (3), wherein the counter locking organ (35) is formed at the retainer (30).

20. Mating connector (3) according to claim 19, **characterised in that** the retainer (30) is provided with at least one fixation member (37) and the pocket (31) is provided with at least one counter fixation member (38), wherein in an assembled state (S) of the mating connector (3), the fixation member (37) is in engagement with the counter fixation member (38) so that the retainer (30) is locked within the pocket (31).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42b
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43
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23c
22
41
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23b
23a
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40
22a
41
25
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34
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36
30
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43a
23
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32
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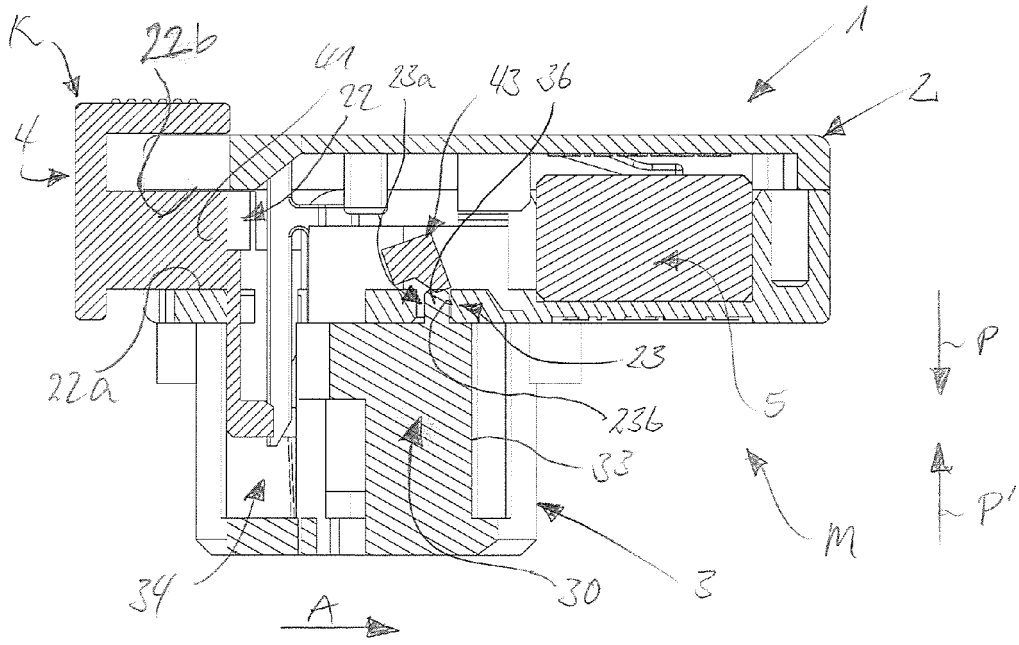
3
5
N
P
P'

Fig. 1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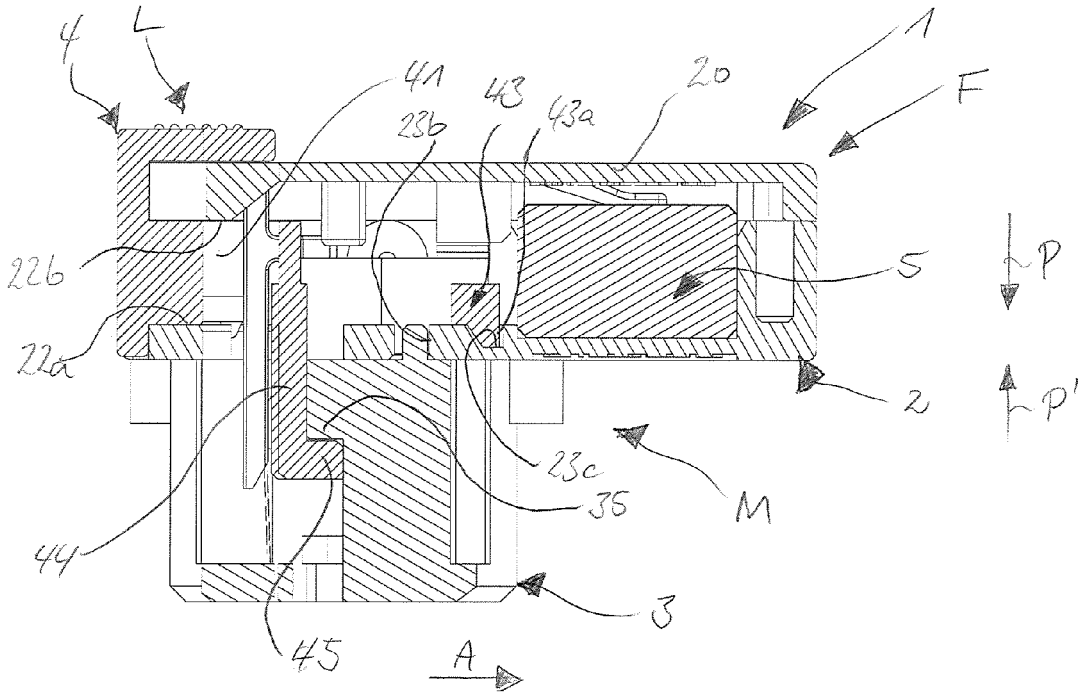
3
A
P
P'

Fig. 2


4
L
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43
43a
20
1
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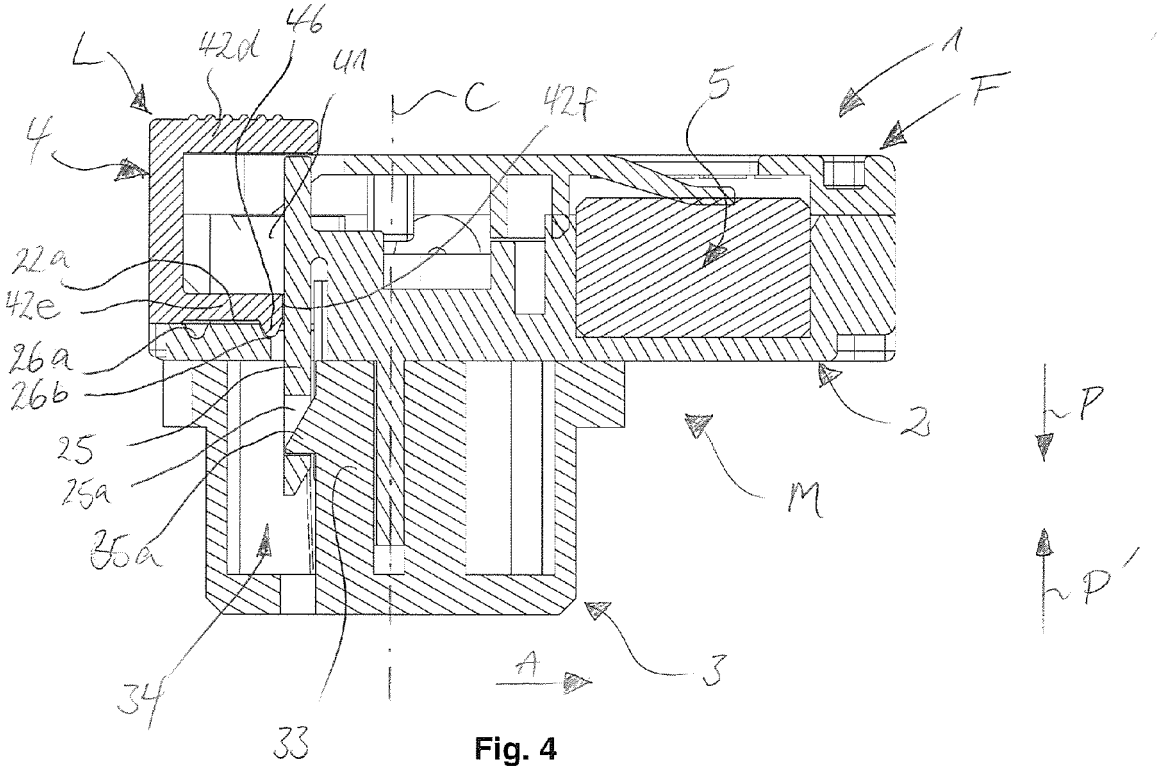
5
P
22a
2
P'
23c
35
M
44
3
45
A

Fig. 3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C
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5
1
F
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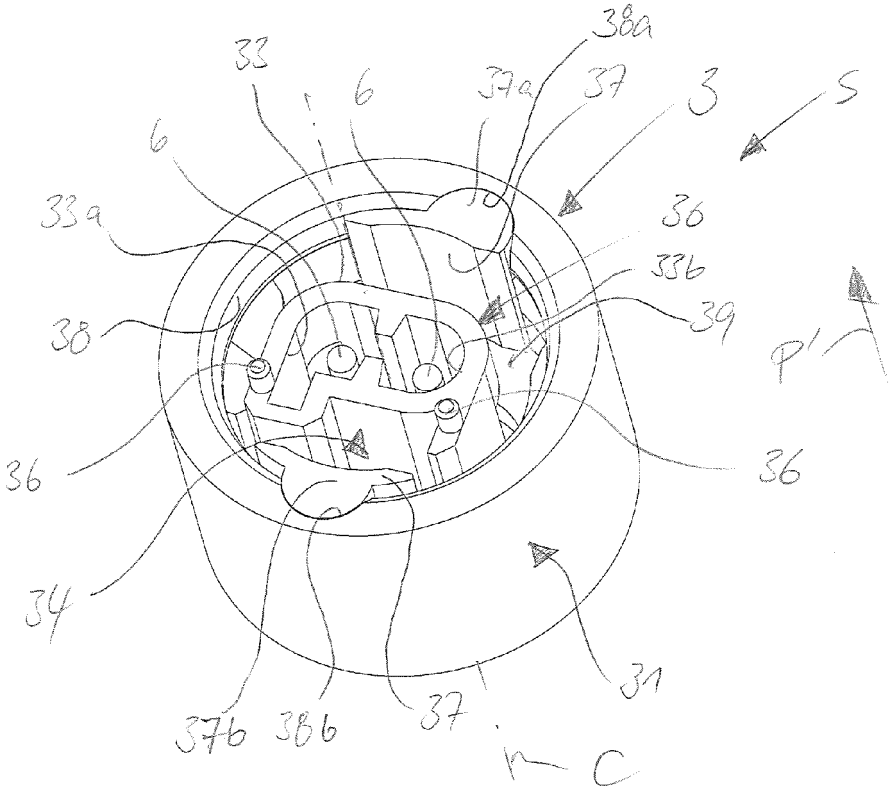
26b
25
25a
35a
2
P
M
P'
34
33
A
3

Fig. 4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37a
37
3
S
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P'
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36
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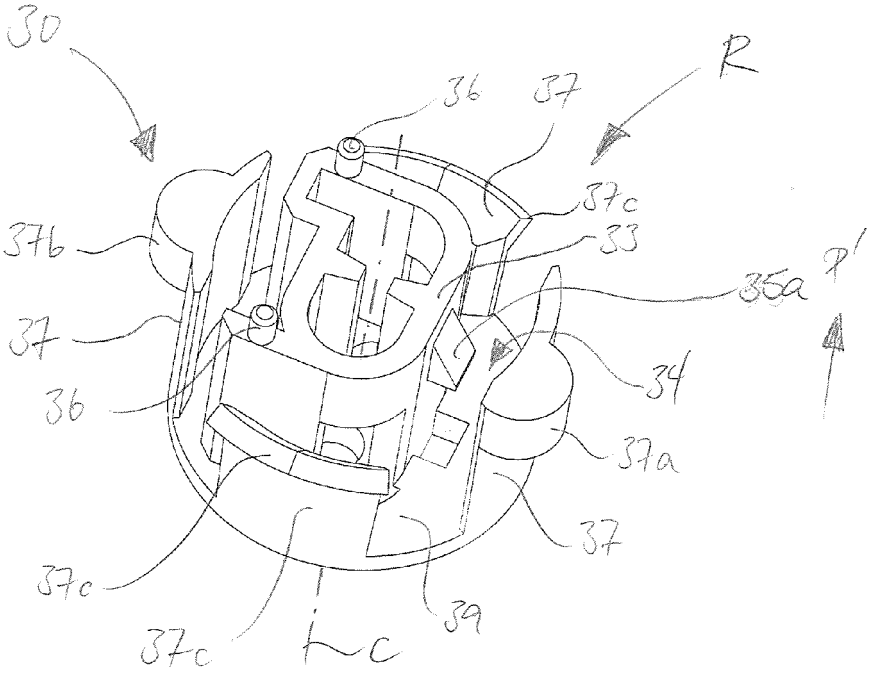
37
31
C

Fig. 5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39
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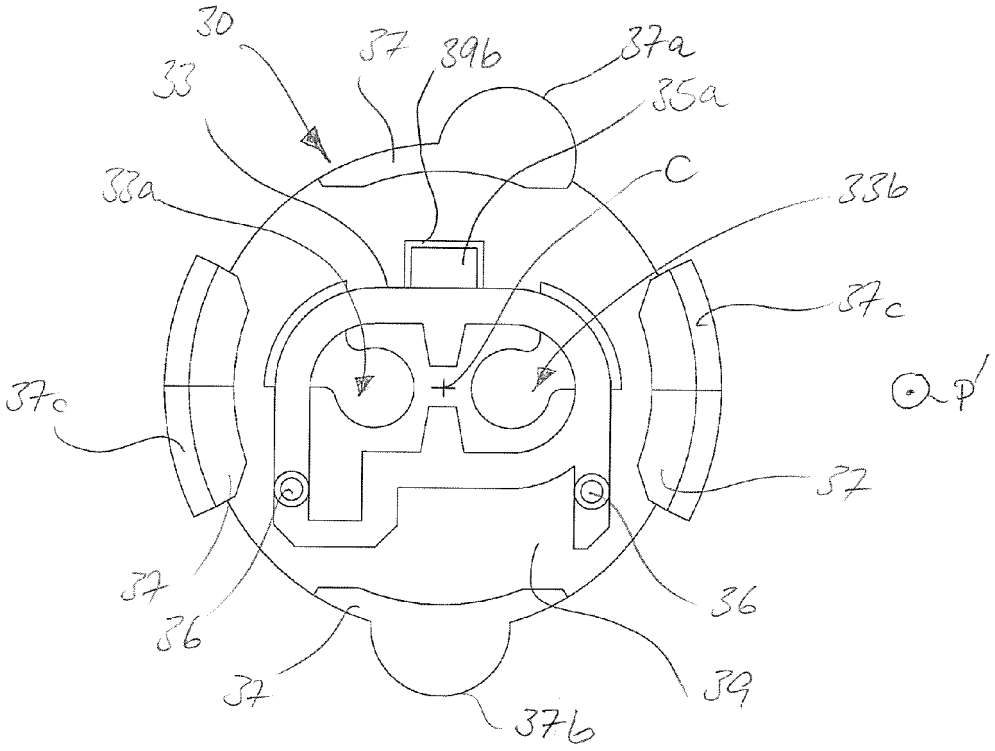
Fig. 6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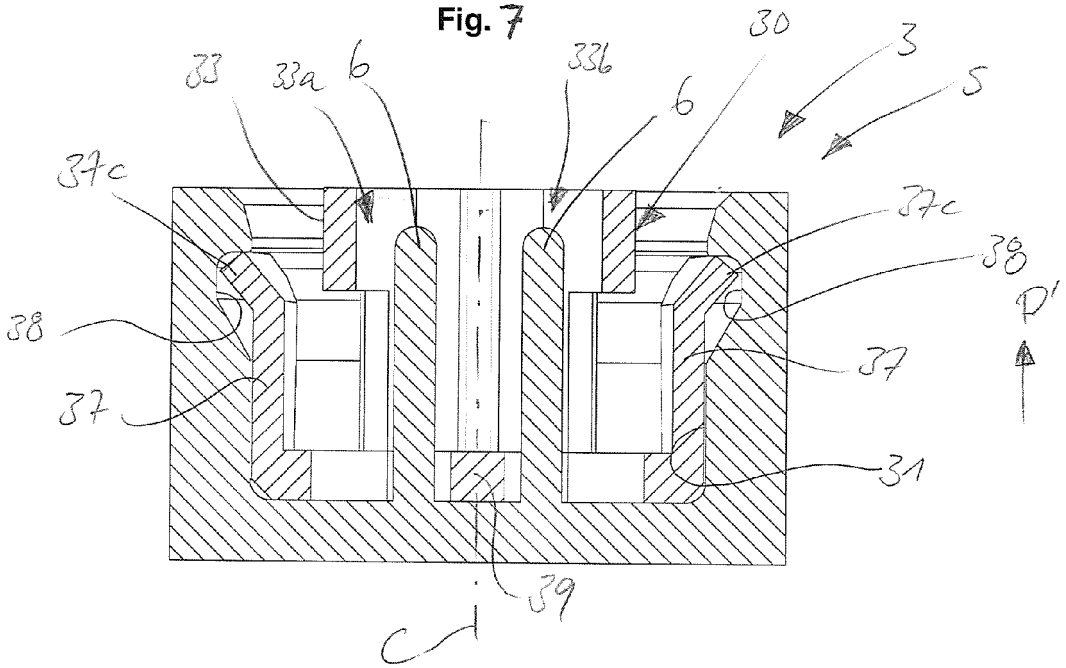
39
37b

Fig. 7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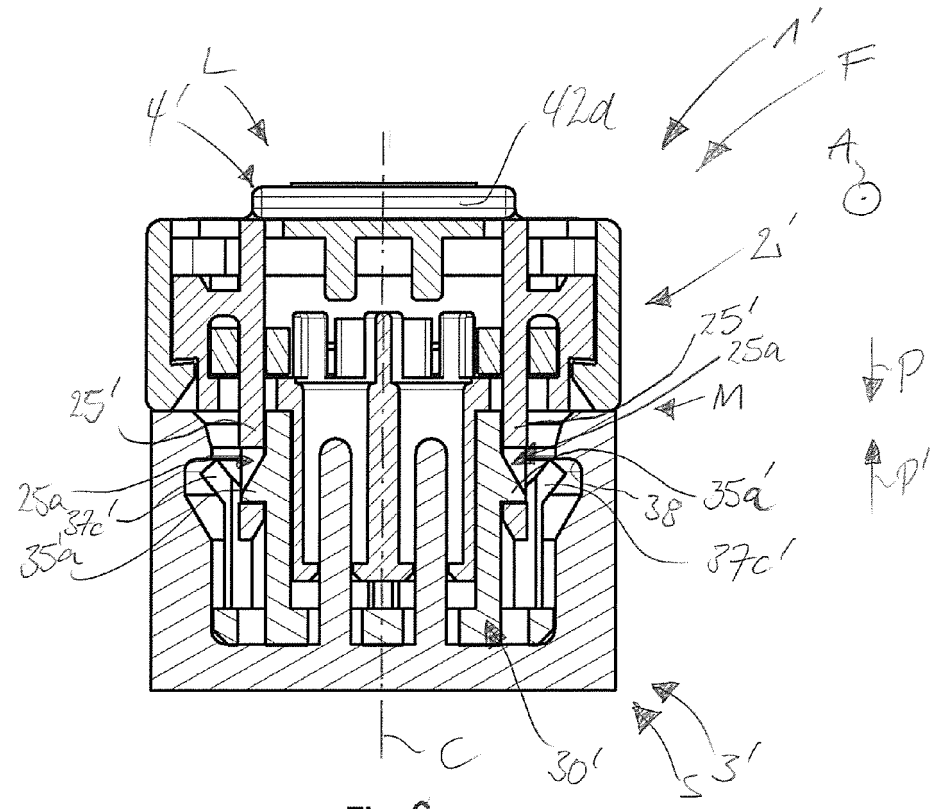
37c
37c
38
38
P'
37
37
31
39
C

Fig. 8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F
L
4'
42d
A
2'
25'
25a
M
P
P'
25'
25a
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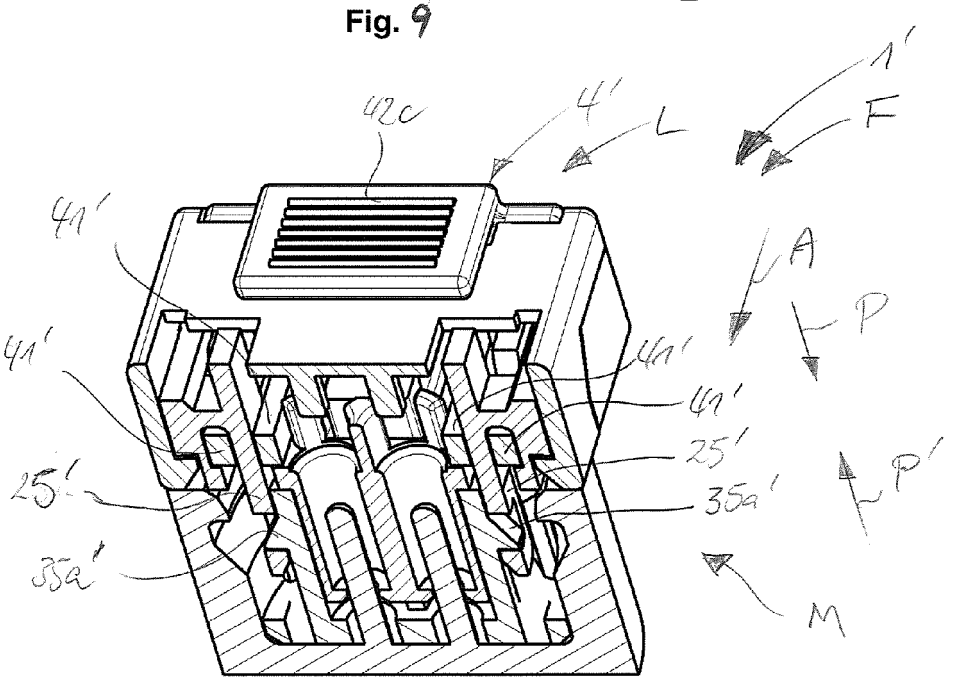
35a'
38
35a'
37c'
C
30'
S
3'

Fig. 9


1'
F
42c
4'
L
41'
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P
41'
41'
41'
25'
25'
35a'
P'
35a'
M

Fig. 10

(Prior Art)

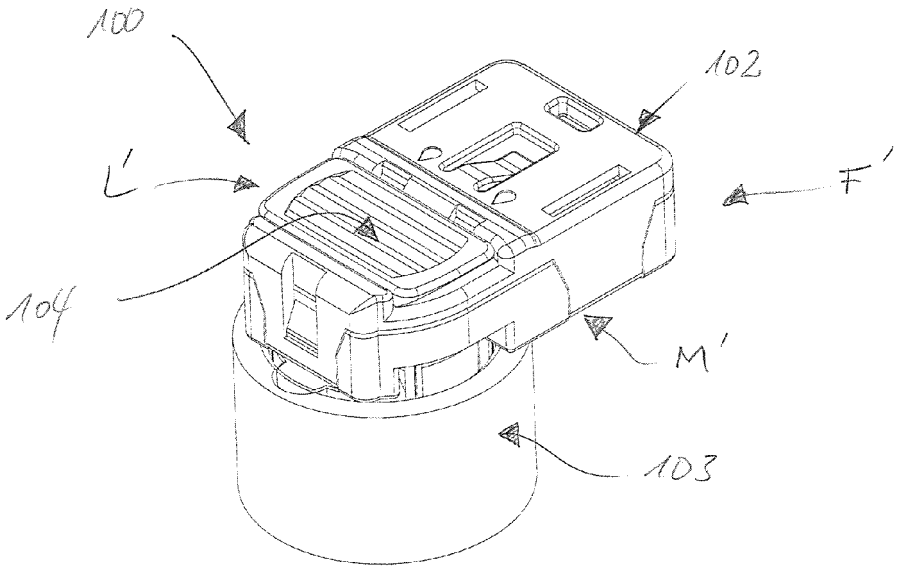

Fig. 11

(Prior Art)

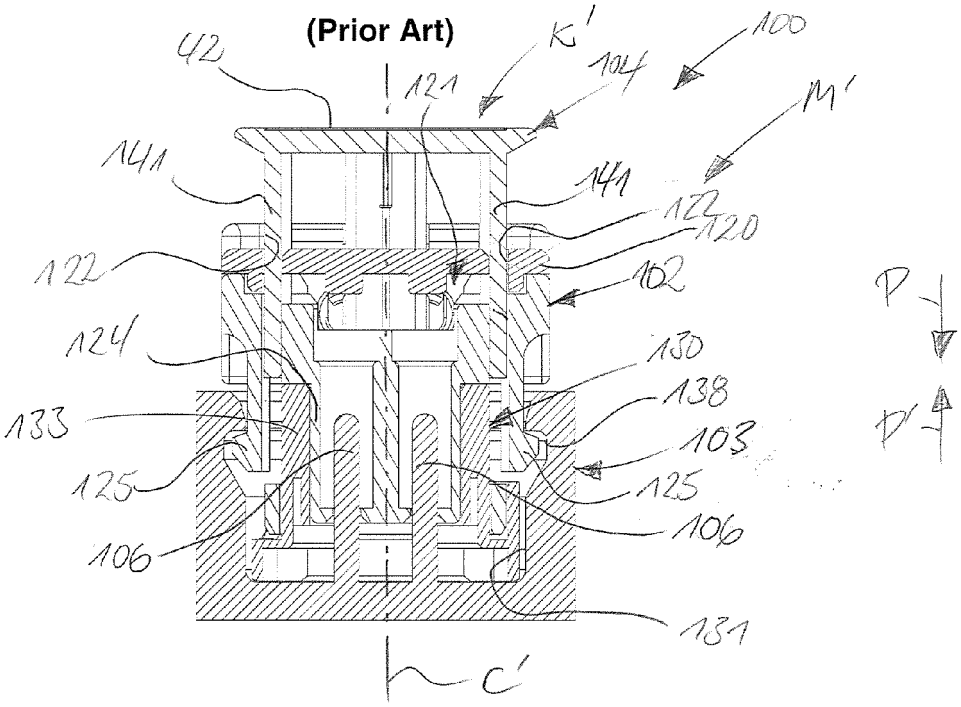

Fig. 12

(Prior Art)

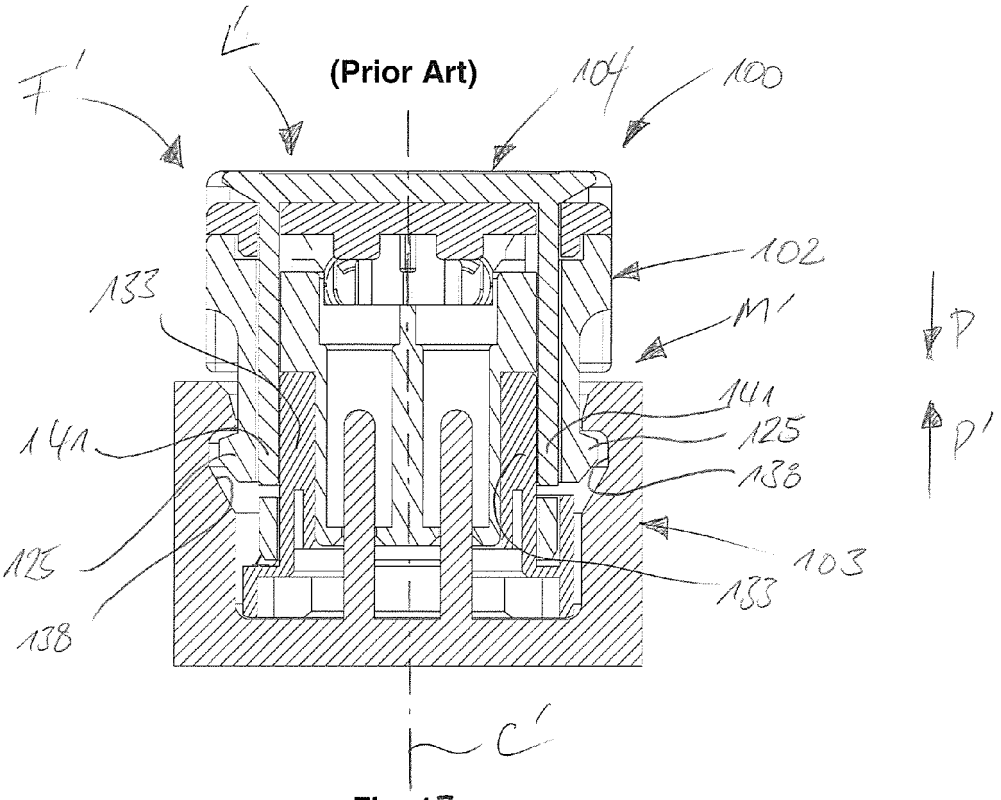

Fig. 13

(Prior Art)

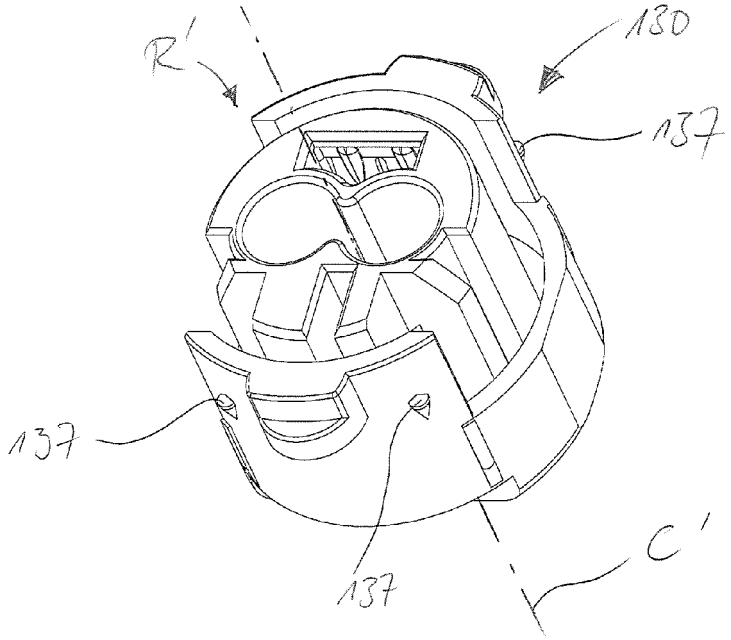

Fig. 14

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 6217

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 Y	US 5 435 742 A (CECIL JR PAUL D [US]) 25 July 1995 (1995-07-25) * the whole document *	1,2,4, 12,15 2-11, 15-20	INV. H01R13/627 H01R13/639 H01R13/641
X	EP 1 575 132 A2 (TYCO ELECTRONICS AMP GMBH [DE]) 14 September 2005 (2005-09-14) * paragraph [0035] - paragraph [0037]; figures 2,3 *	1,2, 12-15	
X	DE 195 25 257 A1 (SIEMENS AG [DE]) 16 January 1997 (1997-01-16) * figures 1,3 *	1,15	
Y	EP 1 130 692 A2 (J S T MFG CO LTD [JP]; TOYOTA MOTOR CO LTD [JP]) 5 September 2001 (2001-09-05) * the whole document *	2-11, 16-18	
Y	WO 2009/053778 A1 (FRAMATOME CONNECTORS INT [FR]; CIRIELLO TOMMASINO [IT]; SCHMIDT THOMAS) 30 April 2009 (2009-04-30) * figures 1,3,5 *	7,8,15, 19,20	TECHNICAL FIELDS SEARCHED (IPC) H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 November 2012	Vautrin, Florent

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20-11-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5435742 A	25-07-1995	DE 69504217 D1	01-10-1998
		DE 69504217 T2	12-05-1999
		EP 0667655 A2	16-08-1995
		JP 2602483 B2	23-04-1997
		JP 7235344 A	05-09-1995
		US 5435742 A	25-07-1995
EP 1575132 A2	14-09-2005	AT 417388 T	15-12-2008
		DE 102004008712 A1	08-09-2005
		EP 1575132 A2	14-09-2005
		ES 2317091 T3	16-04-2009
		US 2005286836 A1	29-12-2005
DE 19525257 A1	16-01-1997	NONE	
EP 1130692 A2	05-09-2001	CN 1312600 A	12-09-2001
		DE 60125443 T2	04-10-2007
		EP 1130692 A2	05-09-2001
		KR 20010087233 A	15-09-2001
		TW 478212 B	01-03-2002
		US 2001027043 A1	04-10-2001
WO 2009053778 A1	30-04-2009	CN 101897084 A	24-11-2010
		EP 2218146 A1	18-08-2010
		US 2010323545 A1	23-12-2010
		WO 2009053778 A1	30-04-2009

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