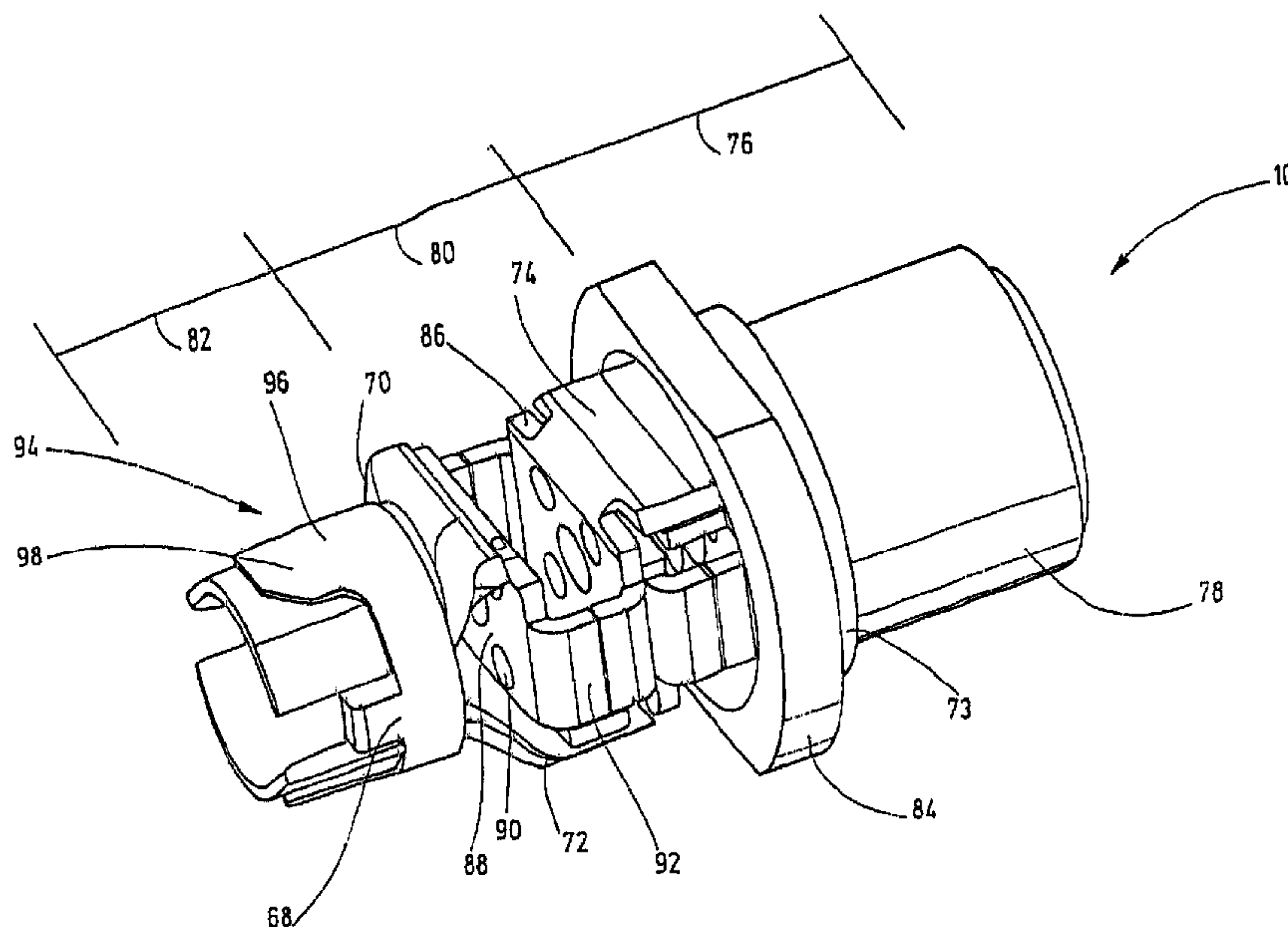




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(54) **Titre : ELEMENT DE CONNEXION ENFICHABLE ELECTRIQUE ET PIECE DE CONNEXION ENFICHABLE COMPORTANT PLUSIEURS ELEMENTS DE CONNEXION ENFICHABLE**
(54) **Title: ELECTRICAL PLUG-IN CONNECTOR ELEMENT AND PLUG-IN CONNECTOR PART COMPRISING A PLURALITY OF PLUG-IN CONNECTOR ELEMENTS**



(57) **Abrégé/Abstract:**

The invention relates to a plug-in connector element (10) having at least two contact plates (72, 74) formed by shaped electrically conductive sheet metal strips, wherein each of said contact plates comprises a connection portion (76) for the electrical connection



(57) Abrégé(suite)/Abstract(continued):

of the plug-in connector element (10) to an electrical line (6), a contact portion (82) for a detachable electrical connection of the plug-in connector element (10) to an associated connecting element, and a compensating portion (80) arranged between the connection portion (76) and the contact portion (82) for a resilient deflection of the contact portion (82) with respect to the connection portion (76), wherein the connection portion (76), the compensating portion (80) and the contact portion (82) are integrally formed from the sheet metal strips (72, 74). The invention also relates to a plug-in connector part comprising a plurality of plug-in connector elements.

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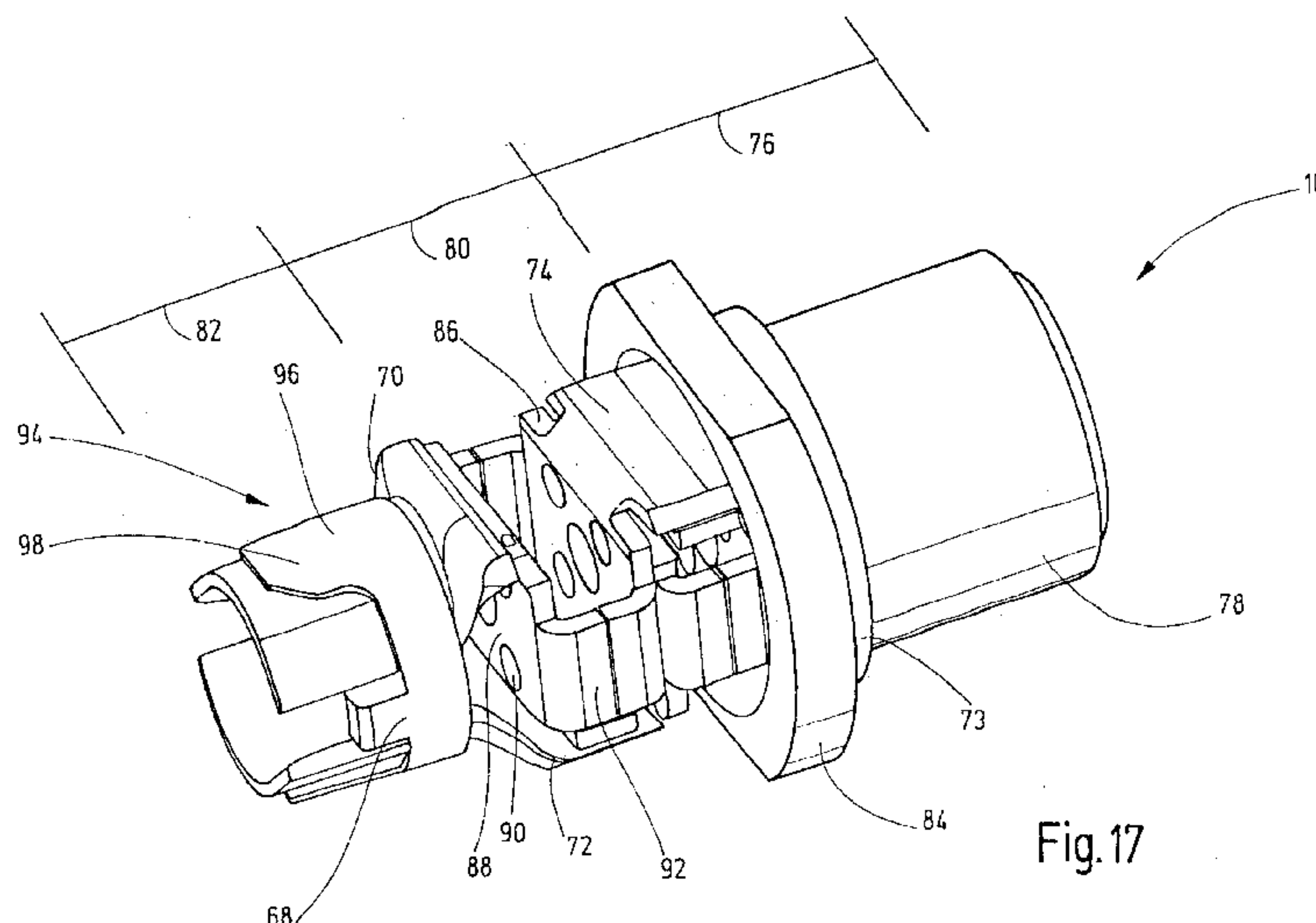
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REN STECKVERBINDUNGSELEMENTEN

Fig.17

(57) **Abstract:** The invention relates to a plug-in connector element (10) having at least two contact plates (72, 74) formed by shaped electrically conductive sheet metal strips, wherein each of said contact plates comprises a connection portion (76) for the electrical connection of the plug-in connector element (10) to an electrical line (6), a contact portion (82) for a detachable electrical connection of the plug-in connector element (10) to an associated connecting element, and a compensating portion (80) arranged between the connection portion (76) and the contact portion (82) for a resilient deflection of the contact portion (82) with respect to the connection portion (76), wherein the connection portion (76), the compensating portion (80) and the contact portion (82) are integrally formed from the sheet metal strips (72, 74). The invention also relates to a plug-in connector part comprising a plurality of plug-in connector elements.

(57) Zusammenfassung:

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WO 2011/128075 A9

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Die Erfindung betrifft ein Steckverbindungselement (10) mit mindestens zwei durch geformte elektrisch leitfähige Blechstreifen gebildeten Kontaktblechen (72, 74), die jeweils aufweisen einen Anschlussabschnitt (76) für den elektrischen Anschluss des Steckverbindungselements (10) an eine elektrische Leitung (6), einen Kontaktabschnitt (82) für ein lösbares elektrisches Verbinden des Steckverbindungselements (10) mit einem zugeordneten Verbindungselement, und einem zwischen dem Anschlussabschnitt (76) und dem Kontaktabschnitt (82) angeordneten Ausgleichsabschnitt (80) für eine elastische Auslenkung des Kontaktabschnitts (82) gegenüber dem Anschlussabschnitt (76), wobei der Anschlussabschnitt (76), der Ausgleichsabschnitt (80) und der Kontaktabschnitt (82) einstückig von den Blechstreifen (72, 74) ausgebildet sind, sowie ein Steckverbindungsteil mit mehreren Steckverbindungselementen.

Electrical Plug-In Connector Element and Plug-In Connector Part Comprising a Plurality of Plug-In Connector Elements

The invention relates to an electrical plug-in connector element and a plug-in connector part comprising a plurality of plug-in connector elements.

Typically, in electrical plug-in connectors, a plug element and a socket element are mated, the contact elements of the plug element and of the socket element coming into electrical contact with one another and the electrical current being carried via the contact surfaces which have been produced in this way. Known plug-in connectors call for slotted contacts in which a slot forms two contact surfaces between pin and socket. The embodiment is also known with two slots by which four contact surfaces are formed. The use of so-called laminated contacts yields a larger number of contact surfaces. Here, for example, punched segments are mounted in a contact carrier. The large number of contact surfaces yields high contact stability.

DE 10 2007 042 194 A1 discloses a plug-in connector element with a contact element which has at least one line contact by means of which the contact element can be electrically connected to

an assigned connecting element when mated. The contact properties and current-carrying properties which can be achieved therewith are already very good.

An object of the invention is to provide a plug-in connector element and a plug-in connector part with a plurality of such plug-in connector elements which, compared to known plug-in connector elements and plug-in connector parts, have still further improved performance characteristics. In one embodiment, the intent is to ensure high contact stability and high current-carrying capacity along with simple intermateability; in particular, the plug-in connector element and the plug-in connector part are designed to be insensitive to mechanical and/or thermal loads.

According to an aspect of the present invention, there is provided a plug-in connector element having at least two contact plates formed by shaped, electrically conductive sheet metal strips, wherein each of said contact plates comprises a connecting portion for the electrical connection of the plug-in connector element to an electrical line, a contact portion for a detachable electrical connection of the plug-in connector element to an assigned connecting element, and a compensating portion located between the connecting portion and the contact portion for a resilient deflection of the contact portion relative to the connecting portion, wherein the connecting portion, the compensating portion, and the contact portion are formed in one piece from the sheet metal strips.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the contact plates in the connecting portion are surrounded by a sleeve-shaped connecting element by means of which in an initial state the contact plates are fixed in their position to one another, and that, when the electrical line is connected, a crimp connection of the contact plates to the electrical line can be established by means of the connecting element.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the connecting element extends beyond the crimp region.

2a

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the connecting element has a support element with which the forces that occur when the plug-in connector element is connected to the line can be kept away from the contact portion.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one of the contact plates in the compensating portion has a reduced bending stiffness.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one contact plate is bent in a meander shape in the compensating portion.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one contact plate in the compensating portion has a stop means which is made preferably in one piece in order to limit the deflection of the contact portion relative to the connecting portion.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one contact plate in the contact portion has a cross-sectional shape which differs from the cross-sectional shape of one contact element of the assigned connecting element, is bent especially in a V-shape or U-shape, and thus two electrical line contacts are formed in mating to the assigned connecting element.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the contact plates in the contact portion form a plug-in receiver for a contact element of the assigned connecting element.

2b

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that in the contact portion there is a separate spring with which the contact plates can be kept in direct contact-making contact with the assigned connecting element.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the separate spring has a ring-shaped portion which limits the maximum widening of the contact plates, and has at least one spring arm which projects from the ring-shaped portion and which applies the contact force.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that the separate spring has guide means by which the separate spring can be clipped onto the contact plates guided in a recess between the contact plates.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one contact plate has a stop means which is located preferably on the transition from the contact portion to the compensating portion for the separate spring.

According to another aspect of the present invention, there can be provided the plug-in connector element described herein, characterized in that at least one contact plate has a latching means which interacts with a latching means of the separate spring by latching.

According to another aspect of the present invention, there is provided a plug-in connector part with a plurality of plug-in connector elements as described herein, characterized in that the plug-in connector elements as identical parts are located in a common housing.

2c

According to another aspect of the present invention, there is provided a plug-in connector element, comprising:

parallel first and second contact plates formed of shaped, electrically conductive sheet metal strips; each of said contact plates having a connecting portion for electrical connection to a single electric line only, a contact portion for detachable electrical connection to a single mating plug-in connecting element and a compensating portion between said connecting portion and said contact portion; each said compensating portion being resiliently deflectable for resilient deflecting of the respective contact portion relative to the respective connecting portion; said connecting portion, said compensating portion and said contact portion of each said contact plate being formed in one, unitary piece from the respective sheet metal strip; and

a sleeve-shaped connecting element surrounding said connecting portions fixing said contact plates in position relative to one another in an initial state of said contact plates.

According to another aspect of the present invention, there is provided a plug-in connector part, comprising:

a plurality of identical plug-in connector elements located in a common housing, each of said connector elements including,

parallel first and second contact plates formed of shaped, electrically conductive sheet metal strips; each of said contact plates having a connecting portion for electrical connection to a single electric line only, a contact portion for detachable electrical connection to a single mating plug-in connecting element and a compensating portion between said connecting portion and said contact portion; each said compensating portion being resiliently deflectable for resilient deflecting of the respective contact portion relative to the respective connecting portion; said connecting portion, said compensating portion and said contact portion of each said contact plate being formed in one, unitary piece from the respective sheet metal strip; and

a sleeve-shaped connecting element surrounding said connecting portions fixing said contact plates in position relative to one another in an initial state of said contact plates.

2d

In one embodiment, the plug-in connector element has at least two contact plates formed by shaped, electrically conductive sheet metal strips, wherein each comprises a connecting portion for the electrical connection of the plug-in connector element to the electrical line which is to be connected, a contact portion for a detachable electrical connection of the plug-in connector element to an assigned connecting element, and a compensating portion located between the connecting portion and the contact portion for a resilient deflection of the contact portion relative to the connecting portion, wherein the connecting portion, the compensating portion, and the contact portion are formed in one piece from the sheet metal strips.

The resilient deflection made available by the compensating portion in the mated state of the two plug-in connector parts is advantageous because in this way deviations in the position of the contact pins in the mounted plug-in system may be accommodated and may not lead to reduced contact-making and thus to a reduced current-carrying capacity. Vibrations which occur can be

accommodated by the strain relief described below. The forces necessary for insertion and detachment are adjustable by the insertion bevels and/or contact surfaces and/or the overspring which are provided.

In one embodiment, the three portions are arranged in succession in a longitudinal direction of the plug-in connector element and can make available the function assigned to them without adversely affecting one another. All three portions are formed in one piece by one or more contact plates at a time so that contact sites, for example, between the connecting portion and the contact portion, are avoided.

The contact plates form the contact element of the plug-in connector element. Due to the compensating portion, the contact plates may have sufficient flexibility in spite of a comparatively large cross-sectional area which may offer a high current-carrying capacity. Therefore, the contact plates may be moved directly, i.e., without interposing a contact-making element, into contact with the contact element of the assigned plug-in connector part. Thus, a contact site, which is additionally required in the prior art with high current-carrying capacity at the transition of the contact element to a continuing portion within the plug-in connector element, may be eliminated. The plug-in connector element according to the invention therefore may have a high current-carrying capacity, but also may have improved vibration strength.

The material for the contact plates is preferably pure copper in order to minimize the total resistance of the plug-in connector element. Preferably, the material is low-oxygen or oxygen-free copper. In this way, embrittlement of the contact plates may be prevented at higher temperatures, as can arise, for example, when using the plug-in connector elements according to the invention in automotive engineering, especially for hydrogen-fueled vehicles. The contact portion, or preferably the entire contact plate, can, for example, have a surface coating, for example, of silver or another precious metal, in order to reduce the contact resistances even for high plug-in cycles.

WO 2011/128075

PCT/EP2011/001838

In one embodiment, the contact plates in the connecting portion are surrounded by a connecting element which is sleeve-shaped at least in sections and by means of which, in an initial state, the contact plates are fixed in their position to one another. The contact plates in the connecting portion can be bent into the shape of a partial circle, especially roughly a semicircle, when using two contact plates, so that fixing of the contact plates takes place solely by plugging the connecting portion of the two contact plates into the connecting element.

When the electrical line is connected, a crimp connection of the contact plates to the electrical line is established by means of the connecting element. Using a sleeve ensures durable and aging-resistant contact-making. On its end facing the electrical line which is to be connected, the connecting element preferably has an insertion bevel. The connecting element likewise consists preferably of comparatively soft copper. Preferably, hexagonal compression is undertaken to improve the contact properties and to make available a stable, reliable mechanical connection between the plug-in connector element and the electrical line.

In one embodiment, the sleeve extends beyond the crimp region. In this way, the deformation of the contact plates in the connecting portion does not act on the following compensating portion. In order to further improve this mechanical shielding action, the connecting element in one embodiment has a support element, for example, a single-stage or multistage, especially two-stage, ring-shaped flange, with which the connecting element can be supported alternatively or additionally also on a housing of the pertinent plug-in connector part. In this way, movements and/or vibrations of the connected line, which can be a cable, for example, are absorbed by the assigned connecting element and are not transferred into the contact portion.

In one embodiment, at least one of the contact plates in the compensating portion has a reduced bending stiffness. This can be made available, for example, by one or more recesses in the wall thickness and/or by one or more lateral indentations into the strip width of the contact plates.

This creates a predetermined articulation site which enables a deflection of the contact portion relative to the connecting portion with a comparatively low force. In this way, low insertion forces and/or mainly a compensation of temperature-induced elongation states of the interacting components which consist of different materials may be implemented in an especially advantageous manner. Because the contact plate is fixed in the crimp region, the compensation region may also make available an elasticity of the plug-in connector element which, in spite of production-induced tolerances, may provide an optimum of contact-making in the contact portion.

In one embodiment, at least one contact plate, preferably all and especially two contact plates, of the plug-in connector element is bent in a meander shape in the compensating portion or in any case is offset. In this way, in the contact portion, the contact plates can be deflected with comparatively little expenditure of force such that the plug-in connector element can be mated to an assigned connecting element and such a plug-in connection can be broken with low expenditure of force. In the meander-shaped compensating portion, the two legs, which run parallel in sections, have a distance to one another. This ensures dynamic play during deflection. At the bending sites of the compensating portion, the stiffness of the contact plate can be reduced, for example, by a material recess and, in particular, by a local reduction of the width of the contact plate.

In one embodiment, at least one contact plate in the compensating portion has a stop means which is made preferably in one piece in order to limit the deflection of the contact portion relative to the connecting portion. For example, on at least one leg of the contact plate which runs parallel in the meander region, a lateral extension can be bent in the direction to the opposing leg. At a maximum deflection, the bent portion comes into contact with the opposite leg, as a result of which the deflection is limited.

In one embodiment, at least one contact plate in the contact portion has a cross-sectional shape which deviates from the cross-sectional shape of one contact element of the assigned

WO 2011/128075

PCT/EP2011/001838

connecting element; in this way, in mating with the assigned connecting element, two electrical line contacts are formed. In one embodiment, at least one contact plate of the contact portion is bent into a V-shape or U-shape. When the plug-in connector element is mated to the assigned connecting element, two electrical line contacts are thus formed by each contact plate. In one embodiment, in which the plug-in connector element has two contact plates, a total of four electrical line contacts are thus formed. The length of the line contacts is limited by the length of the contact plates, which are bent into a V-shape or U-shape in the contact portion. In one embodiment, this length is between 2 and 20 mm, especially between 4 and 15 mm, and preferably between 6 and 10 mm. In this way, for example, a short circuit current-carrying capacity of 3000 A for a period of 1 s can be made available.

In one embodiment, the contact plates in the contact portion form a plug-in receiver for a, for example, pin-shaped contact element of the assigned connecting element. The longitudinal axis of the plug-in receiver and thus the plug-in direction can be aligned longitudinally or obliquely and especially transversely to the longitudinal direction of the plug-in connector element, in which the contact portion, the compensating portion, and the connecting portion are arranged in succession.

In one embodiment, in the contact portion there is a separate spring with which the contact plates can be kept in contact-making contact with the assigned connecting element. The separate spring can be produced from a spring steel with suitable elastic materials; in particular, no special electrical properties are necessary. Preferably, the separate spring is produced from a nonmagnetizable material. The separate spring is outside the current path so that electrical contact takes place solely between the contact portion of the contact plate and the contact element of the assigned connecting element.

In one embodiment, the separate spring has a ring-shaped portion which limits the maximum widening of the contact plates in the contact portion. Spring arms can project from the

WO 2011/128075

PCT/EP2011/001838

7

ring-shaped portion, especially in the direction to the end of the contact plate which faces the assigned connecting element, which arms apply the required contact force. The spring arms can be bent radially to the inside in order to be kept in contact with the contact plates. The number of spring arms can agree with the number of contact plates or a multiple of the number of contact plates.

In one embodiment, the separate spring has guide means by which the separate spring can be clipped onto the contact plates guided in a recess which extends in the plug-in direction between the contact plates. The guide means can also project in the plug-in direction from the ring-shaped portion of the separate spring and can be bent radially to the inside.

In one embodiment, a contact plate has a stop means located preferably on the transition from the contact portion to the compensating portion for the separate spring. The stop means can be located, in particular, at the transition from the V-shaped or U-shaped contact portion to the meander of the compensating portion. A depth stop is provided by the stop means when the separate spring is being clipped on.

The invention also relates to a plug-in connector part having a plurality of plug-in connector elements according to the invention as described above, with the plug-in connector elements as identical parts being located in a common housing of the plug-in connector part. In this way, multipole plug-in connector parts in the form of a system of modules can be provided with plug-in connector elements according to the invention. The individual plug-in connector elements of a plug-in connector part can be made completely identically and can also have identical dimensions. Alternatively, the plug-in connector part can also accommodate plug-in connector elements of different dimensions, for example, for load currents of different magnitude.

The plug-in connector element according to the invention can be scaled for rated currents of different magnitude. Thus, for example, for a rated current of 100 A, the contact plate at a width of 8 mm can have a thickness of 0.8 mm, and, in the connecting portion, lines or cables with a cross-sectional area from 16 to 25 mm² can be connected. At a rated current of 200 A, the contact plate at a width of 12 mm can have a thickness of 1.0 mm, and, in the connecting portion, lines or cables with a cross-sectional area from 35 to 50 mm² can be connected. At a rated current of 400 A, the contact plate at a width of 16 mm can have a thickness of 1.25 mm, and, in the connecting portion, lines or cables with a cross-sectional area from 70 to 95 mm² can be connected.

In one embodiment, the plug-in connector elements are designed for electrical voltages in the range of more than 12 V and less than 2400 V, especially more than 24 V and less than 1000 V, and preferably up to an operating voltage of 700 V. In one embodiment, the plug-in connector parts are used in automotive engineering, especially for electric or hybrid vehicles, or for electric prime movers.

Other advantages, features, and details of the invention will become apparent from the following description in which several exemplary embodiments are detailed with reference to the drawings.

- FIG. 1 shows a perspective view of a first exemplary embodiment of a plug-in connector system,
- FIG. 2 shows a perspective view of a second exemplary embodiment of a plug-in connector system,
- FIG. 3 shows a perspective view of a third exemplary embodiment of a plug-in connector system,
- FIG. 4 shows a side view of the plug-in connector system of FIG. 3,

WO 2011/128075

PCT/EP2011/001838

- FIG. 5 shows a perspective view of the plug-in connector system in a partially separated state,
- FIG. 6 shows in a perspective view an enlarged extract in the region of the latching means,
- FIG. 7 shows an enlarged extract in the region of the latching elements,
- FIG. 8 shows an extract of a section through the housing of the first plug-in connector part,
- FIG. 9 shows a perspective view of one section of the line with the insulation stripped on the conductor end,
- FIG. 10 shows a perspective view of one section of the line with an alternative embodiment of a shielding element,
- FIG. 11 shows a top view of the first part of the shielding element,
- FIG. 12 shows a side view of one section through the first part of the shielding element,
- FIG. 13 shows a section through a second part of the shielding element,
- FIG. 14 shows an extract of a section through a second exemplary embodiment of a housing of the first plug-in connector part,
- FIG. 15 shows a perspective view of an extract of the second plug-in connector part in the region of the pilot contact,
- FIG. 16 shows an extract of a section through the housing of the first plug-in connector part,
- FIG. 17 shows a perspective view of a first exemplary embodiment of a plug-in connector element,
- FIG. 18 shows a perspective view of a second exemplary embodiment of a plug-in connector element,
- FIG. 19 shows an exemplary embodiment of a plug-in connector element for a right angle plug, and
- FIG. 20 shows another exemplary embodiment of a plug-in connector element for a right angle plug.

FIG. 1 shows a perspective view of a first exemplary embodiment of a plug-in connector system 1 having a first plug-in connector part 2 and a second plug-in connector part 4 in the as-yet unmated state. The first plug-in connector part 2 is designed as a three-pole plug with which three single-pole electrical lines 6, which are each made as a cable with a cable jacket, can be electrically connected to the second plug-in connector part 4. For this purpose, in a housing 48 there are, for example, the sleeve-shaped contact elements which are shown in FIGS. 17 and 18 and which can be brought into electrical contact with preferably cylindrical contact pins 22 in the second plug-in connector part 4 when the first and second plug-in connector parts 2, 4 are mated.

The second plug-in connector part 4 in the exemplary embodiment is located on a housing wall 8 of a generating set, for example, on a generator or on an electric motor. The first and second plug-in connector parts 2, 4 each have three load contacts 12, 14, 16 which are used for electrically connecting the electrical lines 6, and one pilot contact 18, of which in FIG. 1 only the pertinent pilot contact of the second plug-in connector part 4 is partially visible.

The two plug-in connector parts 2, 4 moreover have components 20 for guiding the first plug-in connector part 2 when mated with the second plug-in connector part 4, whereby on the sides of the second plug-in connector part 4 as a guide component, there is a pin 24, which is cylindrical at least in sections and which is tapered on its end facing the first plug-in connector part 2 and is especially rounded and/or has a conical surface.

Between the components 20 for guidance and the pilot contact 18, the two plug-in connector parts 2, 4 have components for interlocking the first plug-in connector part 2 on the second plug-in connector part 4, which in the exemplary embodiment on the side of the first plug-in connector part 2 has a connecting screw 26 and on sides of the second plug-in connector part 4 has a threaded hole 28. The second plug-in connector part 4 is preferably detachably mounted by means of a terminal strip 30 on the housing wall 8; in the exemplary embodiment it is screwed on.

WO 2011/128075

PCT/EP2011/001838

In the first exemplary embodiment of FIG. 1, the first plug-in connector part 2 has a line guide which runs parallel to the plug-in direction. FIG. 2 shows a second exemplary embodiment of a plug-in connector system 1 in which the first plug-in connector part 102 has a line guide of the electrical lines 6 which runs angled to the plug-in direction, especially a line guide angled by 90°. The second plug-in connector part 4 is made identically to the second plug-in connector part 4 of the first exemplary embodiment of FIG. 1; in particular, both a first plug-in connector part 2 with a line guide which runs parallel to the plug-in direction, as shown in FIG. 1, and also a first plug-in connector part 102 with a line guide which runs angled to the plug-in direction can be mated to the same second plug-in connector part 4.

The components of a first component group with components for the pilot contact 18 and the components for the three load contacts 12, 14, 16 are always independent of a pole number of the first plug-in connector part 102 that is determined by the number of load contacts 12, 14, 16; in particular, the pilot contact 18 is always made identically, regardless of whether it is a one-pole, two-pole, or n-pole plug-in connection. This is likewise true of the load contacts 12, 14, 16 in the straight version and the load contacts 212, 214 in the angled version (FIG. 3). The components 20 for guidance during mating and the components 26 for the fixing of the first plug-in connector part 2 on the second plug-in connector part 4 are made independently of the number of poles.

The housing 48 of the first plug-in connector part 2 has a number of receiving chambers for the components of the load contacts 12, 14, 16, which number corresponds to the pole number determined by the number of load contacts 12, 14, 16. The components of the load contacts 12, 14, 16 which are located within the housing 48 are made identically. The components 20 for guidance during mating and the components of the pilot contact 18 and of the fixing 26 are located between the first load contact 12 which is located on the left in FIGS. 1 and 2 and the middle load contact 14. In one embodiment, this arrangement is also retained for two-pole or multipole plug-in connections; in particular, the arrangement of the components 20 for guidance, of the pilot contact 18, and of the

WO 2011/128075

PCT/EP2011/001838

12

connecting means 26 is always located between two adjacent load contacts 12, 14, regardless of the number of poles of the plug-in connector system 1.

The second plug-in connector part 4 has a sleeve-shaped portion 32 which projects over the contact pin 22 in the axial direction and which can be used for further guidance of the first plug-in connector part 2, 102 when mated to the second plug-in connector part 4. The sleeve-shaped portion 32 has an opening 34 which extends in the plug-in direction, which is open in the direction of the first plug-in connector part 2, 102 and which in the exemplary embodiment is formed by a slot. In the mated state, the first plug-in connector part 2, 102 with its housing 48 projects beyond one end 36 of the opening 34, which end faces the second plug-in connector part 4. This is followed by a ring-shaped and preferably cylindrical or conical portion 38 with which in the mated state a sealing means can be brought into contact and thus seals the contact elements of the plug-in connector system 1. On its inside, the sleeve-shaped portion 32 preferably has guide means 40 which are made in one piece, which extend in the axial direction in the exemplary embodiment and which are made as crosspieces, and by which further guidance and/or reverse voltage protection is ensured during mating. In one embodiment, the guide means and crosspieces as well as the pertinent recesses can form customer-specific coding of the plug-in connector system 1.

FIG. 3 shows a perspective view of a third exemplary embodiment of a plug-in connector system 201 with a two-pole first plug-in connector part 202 and a two-pole second plug-in connector part 204, with the first plug-in connector part 202 being a right angle plug, in which the line guide runs at a right angle to the plug-in direction.

FIG. 4 shows a side view of the plug-in connector system 201 of FIG. 3. FIG. 5 shows a perspective view of the plug-in connector system 201 in a partially separated state in a view which has been enlarged relative to FIGS. 3 and 4.

WO 2011/128075

PCT/EP2011/001838

The first plug-in connector part 202 has a U-shaped actuating element 242 with which the two plug-in connector parts 202, 204 can be transferred out of the completely mated state in FIGS. 3 and 4 into a state shown in FIG. 5 in which the pilot contact 218 is either already separated, or, at least, is separated with a complete transfer of the actuating element 242 into a position which has been turned by 90° relative to FIGS. 3 and 4, where, however, the load contacts 212, 214 are still electrically connected. The actuating element 242 can be pivoted around an axle journal 244 which is formed preferably integrally from the first plug-in connector part 202, whereupon a radial cam 246, which is made in the actuating element 242, for example, by a groove, is moved along a guide journal 250 located on the second plug-in connector part 204 such that the first plug-in connector part 202 rises off the second plug-in connector part 204.

When the actuating element 242 assumes a position which has been turned by 90° relative to the position in FIG. 3, the pilot contact 218 of the first plug-in connector element 202 is no longer electrically connected to the pilot contact of the second plug-in connector element 204, whereas the load contacts 212, 214 of the first plug-in connector element 202 are still electrically connected to the load contacts of the second plug-in connector element 204.

The actuating element 242 can be detachably locked in its first end position shown in FIGS. 3 and 4 and/or in a second end position which is turned conversely by 90°. Due to the lever action of the actuating element 242, both when breaking and also when making the connection between the first and the second plug-in connector part 202, 204, only a small actuating force is necessary. This is especially advantageous at high temperatures and/or under dirty ambient conditions.

The first plug-in connector part 202 and the second plug-in connector part 204 have latching means 252, 254 which correspond to one another, in the exemplary embodiment, with the latching means 252 of the first plug-in connector part 202 being formed by a recess in one housing wall which is engaged by the pertinent latching means 254 of the second plug-in connector part 204 as it

WO 2011/128075

PCT/EP2011/001838

is being fitted on and in doing so locks to the opening. For this purpose, the latching means 254 of the second plug-in connector part 204 has a starting bevel by which the latching means 254 is deflected during mating and snaps back as soon as the latching means 254 engages the opening in the first plug-in connector part 202.

After the first plug-in connector part 202 is transferred out of the position shown in FIGS. 3 and 4 into the position shown in FIG. 5 or beyond into a position in which the actuating element 242 has been pivoted by 90°, the latching means 254 of the second plug-in connector part 204 is in contact with the edge of the opening of the first plug-in connector part 202, which opening forms the latching means 252. This prevents complete withdrawal of the first plug-in connector part 202. Only after the latching means 254 is disengaged from the latching means 252, for example, by means of a screwdriver or other suitable tool which can be inserted, for example, into the opening and can be subsequently turned, can the first plug-in connector part 202 be completely removed.

In practical applications, there is a time delay of, for example, at least 0.5 to 1 second, because the actuating element 242 must be actuated first, and thus the pilot contact 218 is separated, while the load contacts 212, 214 are still connected, and then the latching means 252, 254 must be disengaged, for example, by means of a tool, or alternatively also manually without a tool, before the first plug-in connector part 202 can be completely withdrawn. This enables coordinating control of switching of the load contacts 212, 214 at no load, since separation of the pilot contact 218 signals that the connection is to be broken.

In mating, it also becomes possible for a connection of the load contacts 212, 214 to be established first by clipping on the first plug-in connector part 202 and for the pilot contact 218 also to be closed only by the subsequent pivoting of the actuating element 242, whereupon a coordinating control line can energize the load lines. Thus both the insertion and also the breaking of the electrical connection of the load contacts 212, 214 can take place at no load, as a result of

which the electrical contacts are protected and a stable, reliable electrical connection can be made available.

FIG. 6 shows in a perspective view an enlarged extract in the region of the latching means 252, 254 in a state in which the first plug-in connector part 202 is completely mated to the second plug-in connector part 204 and both the load contacts 212, 214 and also the pilot contact 218 are closed. FIG. 7 shows an enlarged extract in the region of the latching elements 252, 254 in a state in which the first plug-in connector part 202 has been detached from the second plug-in connector part 204 to such an extent that the pilot contact 218 is separated, but the load contacts 212, 214 are still connected.

The latching element 252 of the first plug-in connector part has a first opening portion 256 which is slightly larger than a first portion 258 of the second latching element 254, but smaller than a second portion 260 of the second latching element 254. In this way, in the position shown in FIG. 7, the second portion 260 comes into contact with the housing 48 of the first plug-in connector part 2 and stops a complete withdrawal of the first plug-in connector part 202 from the second plug-in connector part 204. Only by deflecting the second latching element 254, for example, by means of a tool, is the second portion 260 superimposed on a second opening portion 262 of the first latching element 254, which second portion is larger than the first opening portion and which element is slightly larger than the second portion 260 of the second latching element 254, so that the first plug-in connector part 202 can be removed from the second plug-in connector part 204.

FIG. 8 shows an extract of a section through the housing 48 of the first plug-in connector part 2 in a region in which the electrical line 6 shown in a front view is connected to the first plug-in connector part 2. The line 6 is a cable with an inner conductor 53 which is surrounded by insulation 55 onto which a metallically conductive cable shield 57 is applied outside. On its end, which is hidden by a sleeve-shaped connecting element 78, the inner conductor 53 is electrically and

WO 2011/128075

PCT/EP2011/001838

mechanically connected to an electrical plug-in connector element 10 which is described below (FIGS. 17, 18).

The plug-in connector part 2, which is a device 11 for electrically connecting the cable shield 57 of the electric line 6 to the housing 48, furthermore has a fixing element 81, 85, 87 which has three parts in this exemplary embodiment and by means of which the connecting element 78 and thus the inner conductor 53 are immovably fixed in the housing 48 by positive engagement when a tensile force arises on the line 6. The connecting element 78 is sleeve-shaped at least in sections and is mechanically tightly connected to the inner conductor 53, especially pressed to the inner conductor 53. Pressing takes place with interposition of two contact plates 72, 74 which also integrally form the contact element of the plug-in connector element 10.

The connecting element 78 on at least one end has a flange-like widening 84 which forms a contact surface 79 for a first part 81 of the fixing element, which surface is preferably circularly ring-shaped and forms a positive engagement in the direction of the tensile force. The first part 81 of the fixing element is sleeve-shaped, surrounds the connecting element 78, and extends in the direction to an end which is oriented away from the contact element of the plug-in connector element 10 beyond the connecting element 78. On its face-side end, the first part 81 of the fixing element is in contact with a second part 85 of the fixing element which is likewise made sleeve-shaped and accommodates the line 6 in itself, with the interposition of a connecting lead 83 which extends radially to the outside for the cable shield 57. On its end opposite the first part 81, the second part 85 has a contact surface for a third part 87 of the fixing element which in the direction of the tensile force forms a positive engagement with the housing 48.

The third part 87 of the fixing element in the exemplary embodiment is made clip-shaped, with the pertinent clips being insertable into an opening 89 (FIG. 1) which is intended for this purpose into the housing 48 in a direction obliquely and especially transversely to the plug-in

WO 2011/128075

PCT/EP2011/001838

17

direction or to the longitudinal direction of the line 6 and thus locks the fixing element in the housing 48. When a tensile force arises on the cable 6, this tensile force is transferred via the inner conductor 53 to the connecting element 78 which is in positive contact with the first part 81 of the fixing element; the latter in turn is in positive contact with the second part 85; and the latter in turn is in positive contact with the third part 87, with the third part 87 being in positive contact with the housing 48. In this way, a tight connection between the line 6 and the housing 48 is made available which is based solely on positive contact and is independent of friction forces.

The device 11 is a component of a receiving chamber assigned to each pole for one load contact 12, 14, 16, 212, 214 at a time in each embodiment of the housing 48 of the first plug-in connector part 2. The device 11 can be made identically both for straight plug-in connectors and also for right angle plug-in connectors, except for the execution of the contact elements.

The device 11 moreover has an intermediate element 91 which can be made of a plastic. The intermediate element 91 can also be referred to as an insulating sleeve. The intermediate element 91 encompasses the connecting element 78 at least in sections and projects beyond the connecting element 78 in the direction to the contact element of the plug-in connector element 10. In the illustrated exemplary embodiment, the intermediate element 91 integrally forms a sleeve-shaped guide portion 75 which, when the first and second plug-in connector parts 2, 4 are mated, comes into contact with the sleeve-shaped portion 32 (FIG. 1) of the second plug-in connector part 4 and is guided.

The device 11 has a spring element 93 with which the connecting element 78 in the housing 48 is preloaded in the direction to the positive engagement with the fixing element; in the exemplary embodiment it is preloaded in the direction to the first part 81 of the fixing element. The spring element 93 is, on the one hand, in contact with a shoulder of the intermediate element 91, which shoulder projects radially to the outside; and, on the other hand, is in contact with a shoulder of the

WO 2011/128075

PCT/EP2011/001838

18

housing 48 which projects radially to the inside. Stop means ensure that the spring element 93 can be pressurized only up to a definable value, for example, up to 30% compression.

In a portion between the positive contact with the connecting element 78 and the positive contact with the second part 85 and the connecting lead 83 for a cable shield 57, the first part 81 of the fixing element has a latching means 95 with which the first part 81 can be locked to the intermediate element 91 when the device 11 is being mounted. In the exemplary embodiment, the latching means 95 is formed by a portion of larger radial dimension which can engage a correspondingly shaped recess in the intermediate element 91 by latching. On its end oriented away from the contact element of the plug-in connector element 10, the intermediate element 91 can have a slotted portion, and on the end thereof there can be a starting bevel 97 for locking in of the first part 81.

On its end oriented away from the contact element of the plug-in connector 10, the second part 85 of the fixing element projects beyond the end of the housing 48, as a result of which the electric line 6 is guided. On the inside near this axial end between the second part 85 and the line 6, there is a sealing element 99 which in the axial direction forms several sealing surfaces and in the exemplary embodiment has the cross-sectional shape of a corrugated tube. The sealing element 99 also ensures guidance of the line 6 in the housing 48. In the region of the sealing element 99, radially to the outside, the third part 87 of the fixing element is in contact with the inner surface of the housing 48 by another sealing element 77; the third part 87 can also be referred to as an interlock.

FIG. 9 shows a perspective view of a portion of the line 6 with the insulation 55 stripped on the conductor end and the inner conductor 53 which is thus exposed. In the region of the insulation 55, a substantially ring-shaped shielding element 59 makes electrical contact with the cable shield 57 (FIG. 8). The shielding element 59 can be formed from a flat sheet metal part which has been

WO 2011/128075

PCT/EP2011/001838

produced by punching and which in the formed state has a ring-shaped portion with which the shielding element 59 can be brought into contact with the line 6 which is to be connected. Moreover, the shielding element 59 in the peripheral direction has radially projecting contact tongues 61, preferably uniformly distributed, which can be brought into contact with the housing 48 and, in this way, make electrical contact with the housing 48. The shielding element 59 has slots 63 which extend in the direction of the inner conductor 53, which are located preferably uniformly distributed in the peripheral direction and which reduce the eddy currents which occur in the shielding element 59.

FIG. 10 shows a perspective view of one portion of the line 6 with an alternative embodiment of a shielding element 159 which is made in several parts. A first part 131 of the shielding element 159 can be made as a punched/bent part and can have a continuous axial slot 133 by which the first part 131 can be elastically deformed; the first part 131 can also be referred to as a shielding contact. FIG. 11 shows a top view of the first part 131, and FIG. 12 shows a side view of a section through the first part 131. The first part 131 forms a contact element for the cable shield 57 of the line 6. FIG. 13 shows a section through a second part 135 of the shielding element 159 with which the cable shield 57 can make electrical contact and in particular an electrically conductive connection can be established between the cable shield 57 and the first part 131; the second part 135 can also be referred to as a shield crimp.

FIG. 14 shows an extract of a section through a second exemplary embodiment of a housing 148 of the first plug-in connector part 2. To the extent that corresponding features are designated the same way as in the exemplary embodiment of FIG. 8, reference numbers are used which are increased by 100 relative to the reference numbers used in FIG. 8. In the exemplary embodiment of FIG. 14, a shielding element 159 is used as is shown in FIGS. 10 to 13. The shielding element 159 encompasses a third part 137 with which the cable shield 157 of the line 106 is mechanically fixed, especially crimped; the third part 137 can also be referred to as a support crimp. The third part 137

WO 2011/128075

PCT/EP2011/001838

20

tightly surrounds both the cable shield 157 on the insulation 155 and also the outer cable jacket of the line 106. The portion of the third part 137 which surrounds the insulation 155 and the cable shield 157 is spaced axially apart from the portion of the third part 137 which surrounds the outer cable jacket. The exemplary embodiment of the housing 148 of FIG. 14, like the exemplary embodiment of FIG. 8, is cone-shaped inside. In contrast to FIG. 8, in the housing 148 of FIG. 14, the outside shape is also conical since the wall thickness is roughly the same.

The projecting end of the cable shield 157 which has been shortened to a suitable length is turned up over the portion which surrounds the insulation 155 and the cable shield 157 and is surrounded by the second part 135 of the shielding element 159. The second part 135 is shaped such that its outer edge extends almost to the inner surface of the housing 148. To stiffen the face-side end of the second part 135, the end has a stiffening means 139 which in the exemplary embodiment is formed by a ring-shaped depression. On the outside, the second part 135 has a preferably peripherally running edge portion 141 which extends at a right angle to the longitudinal axis and which in the exemplary embodiment is set back from the axial ends of the second part 135, with the distance to the one axial end being less than to the opposite, other axial end.

On the outer edge, the second part 185 of the fixing element is positively supported in the axial direction; the second part 185 can also be referred to as a sealing sleeve. On the face-side end of the second part 135 of the shielding element 159, the first part 181 of the fixing element is positively supported in the axial direction, with the support of the first part 181 lying radially inside compared to the support of the second part 185 of the fixing element; the first part 181 can also be referred to as a spacer sleeve. In the exemplary embodiment, the second part 135 is rotationally symmetrical to its longitudinal axis. By turning up the cable shield 157, it has a defined distance from the main contact.

WO 2011/128075

PCT/EP2011/001838

Between the edge portion 141 of the second part 135 and the housing 148 is the first part 131 of the shielding element 159. In the exemplary embodiment, it consists of a slotted sleeve which in the undeformed state has a shape that is non-cylindrical, and is especially conical. On or near one axial end, the first part 131 on its outer surface has contact tongues 161 or contact lugs with which electrical contact can be made with the housing 148, which tongues or lugs are arranged preferably uniformly distributed in the peripheral direction and which are formed in one piece by embossing. On or near the opposite end, the first part 131 on its inside has second contact tongues 143 or contact lugs with which electrical contact can be made with the second part 135 of the shielding element 159, which tongues or lugs are arranged preferably uniformly distributed in the peripheral direction and which are formed in one piece by embossing.

In the installed state, which is shown in FIG. 14, the first part 131 is formed roughly into a cylindrical shape, since the cable of the line 106 with the parts mounted thereon is pushed into the housing 148 when it is being mounted. Due to the reset force of the first part 131, the latter is in reliable electrical contact, on the one hand, with the inner surface of the housing 148 and, on the other hand, with the second part 135 of the shielding element 159. On the end of the first part 131, there are stop means made preferably in one piece for contact with the second part 135, especially for contact with the edge portion 141 of the second part 135, which ensure that the first part 131 is axially in a defined position in the housing 148, especially in a defined position relative to the second part 135 and thus relative to the line 106. The stop means can be formed by the second contact tongues 143.

The arrangement of the three contact tongues 161 at a time or three second contact tongues 143 ensures a defined contact of the first part 131 both radially to the outside with the housing 148 and also radially to the inside. For each radially outer contact tongue 161, there is one radially inner second contact tongue 143, the connecting line running between contact tongues 161, 143 which are assigned to one another parallel to the longitudinal axis of the line 106 in order to ensure a

corresponding current flow direction for the cable shield current. The short distance between the sleeve-shaped first part 131 and the housing 148 ensures good capacitive coupling of the shielding contact.

The outside diameter of the second part 135 in the region of the edge portion 141 is only slightly less than the inside width of the housing 148 minus the thickness of the first part 131, so that in this region there is play of less than 2 mm, especially less than 1.2 mm, and preferably less than 0.8 mm; in the exemplary embodiment the distance is roughly 0.5 mm. When there is a radial movement of the line 106, especially of the cable with the parts attached to it, i.e., also with the second part 135, the first part 131 moves at that axial position at which the first part 131 makes electrical contact with the second part 135, likewise, where the movement experiences a stop when the first part 131 makes contact with the inside of the housing 148.

On its opposite end, the first part 131 conversely does not move in the radial direction, since the first part 131 is centered by the contact of the contact tongues 161 within the housing 148. In this way, the first part 131 is pivoted; this has the advantage that in this way relative movement takes place at the contact site, as a result of which the contact surfaces are cleaned. The end portion of the first part 131, with which the first part 131 is connected to the second part 135, is bent to the inside relative to the bordering portion by an angle of more than 0.2° and less than 6° , especially more than 0.5° and less than 4° , and preferably more than 0.5° and less than 2.5° , so that this end portion does not experience bending stress during a pivoting motion of the first part 131; this stress would be disadvantageous should vibrations occur. The length of the bent portion is less than 30% of the length of the first part 131, especially less than 20%, and preferably less than 15%. In the exemplary embodiment, the length of the bent portion is equal to the length of the second contact tongues 143 $\pm 25\%$.

FIG. 15 shows a perspective view of an extract of the second plug-in connector part 4 in the region of the pilot contact 18. On its end facing the terminal strip 30, an electrically conductive, loosely attached sleeve-shaped portion 64 on the plug-in unit for the pilot contact 18 has a flange-like widening 66 with which a contact lug 65 which is formed preferably in one piece from the terminal strip 30 can be brought into contact-making contact, and the contact lug 65 can be deflected elastically relative to the terminal strip 30, fixes the sleeve-shaped portion 64 to the housing wall 8, and ensures shield linkage. In one embodiment, the contact lugs 65 are press pads for the conductive sleeve which is bent down on the end with flange-like widening 66 which places the shield linkage at the potential of the generating set.

FIG. 16 shows an extract of a section through the housing 48 of the first plug-in connector part 2 and the housing wall 8 of the generating set with the second plug-in connector part 4 in the mated state. Between the sleeve-shaped portion 32 of the second plug-in connector part 4 and the housing 48 of the first plug-in connector part 2, there is a seal 69, especially in contact with the ring-shaped portion 38 (FIG. 1) of the sleeve-shaped portion 32 on the one hand and the housing 48 on the other. The guide portion 75 of the first plug-in connector part 2, in the direction to the second plug-in connector part 4, is beyond the contact elements of the first plug-in connector part 2, so that they are located shockproof in the first plug-in connector part 2. A dome 67, which is formed preferably in one piece by the terminal strip 30, is in contact-making contact with the housing 48 of the first plug-in connector part 2. In one embodiment, the terminal strip 30 in the region of the passage of the load contacts 12, 14, 16 thus forms a positive counterhold for the housing 48.

FIG. 17 shows a perspective view of a first exemplary embodiment of a plug-in connector element 10 for use in the above-described first plug-in connector part 2. The plug-in connector element 10 has two contact plates 72, 74 which are formed by shaped, electrically conductive sheet metal strips and which each have a connecting portion 76, which in FIG. 17 is hidden by the sleeve-shaped connecting element 78, for electrically connecting the plug-in connector element 10 to the

electric line 6. Furthermore, the contact plates 72, 74 have a contact portion 82 for a detachable electrical connection of the plug-in connector element 10 to a contact element of the second plug-in connector part 4. Furthermore, the contact plates 72, 74 have a compensating portion 80 which is located between the connecting portion 76 and the contact portion 82 for elastically deflecting the contact portion 82 relative to the connecting portion 76.

In the region of the connecting portion 76, the two contact plates 72, 74 are bent into the shape of a partial circle, especially roughly into a semicircle, and are fixed in the illustrated position by the sleeve 78. The connecting element 78, on its end facing the contact portion 82, has a support element 84 which is formed by a flange-like widening and by means of which the connecting element 78 can be supported on an opposite element. As described above, thus the connecting element and thus the line 6 can be fixed by positive engagement in the housing 48 of the first plug-in connector element 2 when a tensile force arises; tensile forces or, for example, vibrations are thus not relayed to the contact portion 82, as a result of which the electrical connection is especially reliable.

The line 6 which is to be connected and which is to be inserted in the connecting portion 76 is stably and reliably connected to the plug-in connector element 10 by crimping of the sleeve 78, especially by the molding-on of a hexagon. The support element 84 causes the forces and/or deformations which occur during crimping to be kept away from the compensating portion 80. For this purpose, it is especially advantageous if another first widening portion 73 is placed ahead of the support element 84, so that the connector element 78 has a two-stage or also multistage widening.

In the compensating portion 80, the two contact plates 72, 74 are each bent in a meander shape, where, proceeding from the connecting portion 76, first the first contact plate 72 forms one U-shaped loop and then in the axial direction the second contact plate 74 forms a substantially equally dimensioned U-shaped loop. Then the two contact plates 72, 74 extend further into the

contact portion 82. On the bending sites of the meandering loops, the two contact plates 72, 74 each have at least one recess 86 by which the strip width of the contact plate 72, 74 is reduced and thus the bending stiffness is reduced. In the two parallel legs 88 of the meandering loop, the two contact plates 72, 74 have tool engagement surfaces 90 which in the exemplary embodiment are formed by holes by means of which the contact plates 72, 74 can be fixed when the loops are bent; alternatively or in addition, there can also be holes for reducing bending stiffness. Moreover, the contact plates 72, 74 in the region of the legs 88 which run parallel have stop means 92 which in the exemplary embodiment are formed by lugs which are bent by 90° and which are formed in one piece by the contact plates 72, 74.

In the contact portion 82, the two contact plates 72, 74 are bent in a V-shape and include an angle of between 60° and 150°, and preferably between 75° and 120°. Alternatively to the V-shape, the contact plates 72, 74 have a bent shape which deviates from the cross-sectional contour of the contact element of the second plug-in connector part 4, so that one or preferably two line contacts per contact plate 72, 74 are created. A separate spring 94 is seated on the contact plates 72, 74 bent in this way, and with it the contact plates 72, 74 can be kept in contact-making contact with the contact element of the assigned second plug-in connector part 4. The separate spring 94 has a ring-shaped portion 96 which limits the maximum widening of the contact plates 72, 74 in the contact portion 82. Spring arms 98 project in the axial direction from the ring-shaped portion 96; in the undeformed state they are bent to the inside and apply the contact force. In the exemplary embodiment, there are two spring arms 98 on opposite sides.

Offset by 90° at a time to the spring arms 98, the separate spring 94 has guide means 68 which are bent on or near its free end radially to the inside and thus engage a gap which has been formed between the two contact plates 72, 74 and, in this way, guide the separate spring 94 when clipped onto the contact portion 82. At the transition from the contact portion 82 to the

WO 2011/128075

PCT/EP2011/001838

26

compensating portion 80, the two contact plates 72, 74 form a stop means 70 for slipping on the separate spring 94 by a radial widening.

FIG. 18 shows a perspective view of a second exemplary embodiment of a plug-in connector element 110 for use in the above-described first plug-in connector part 2. In the contact portion, the first and the second contact plates 172, 174 have lugs 111, 113 which project to the outside and which jointly form a guide and a stop for clipping on the separate spring 194. The ring-shaped portion 115 of the separate spring 194 is located on one end facing the second plug-in connector part 4. From the ring-shaped portion 115, on opposite sides, guide means 117 project which are inserted between the two lugs 111, 113 when the separate spring 194 is clipped on. The guide means 117 have a rounded or beveled end portion. The guide means 117 alternatively or additionally form spacers which prevent the two contact plates 172, 174 from being pressed together to an excessive degree.

Latching means 119 project from the ring-shaped portion 115 on opposite sides and interact with corresponding latching means 121 of the contact plates 172, 174. In the exemplary embodiment, the latching means 119 of the separate spring 194 have an opening or a depression that the latching means 121 which are formed, for example, in one piece by embossing from the contact plates 172, 174, for example, a nub, engage by latching.

On the end side, the ring-shaped portion 115 ends substantially flush with the contact plates 172, 174. The contact plates 172, 174, on the end side, form an insertion bevel 125 for the contact pin 22 (FIG. 1). Each of the contact plates 172, 174, due to its shape, has two line contacts 123 for the contact-making contact with the contact pin 22.

In the region of the connecting portion, especially on its connecting portion-side end, the connecting element 178 has an adjustment means 127 by means of which the position of the

connecting element can be set with reference to the contact plates 172, 174. The adjustment means 127 can be formed by a recess into which, right after the contact plates 172, 174 are inserted, a corresponding positioning is impressed, so that the connecting element 178 is kept only in one definable angular position on the contact plates 172, 174 and in which protection against rotation is ensured during further mounting.

FIG. 19 shows one exemplary embodiment of a plug-in connector element 210 for a right angle plug. In contrast to the plug-in connector element 10 of FIG. 17, one of the contact plates 274 is simply bent at a right angle and need not form a complete meander loop. The contact pin 22 (FIG. 1) is inserted transversely to the longitudinal direction of the plug-in connector element 210, which is defined by the successive arrangement of connecting portion 276, compensating portion 280, and contact portion 282. The separate spring 294 is produced as a punch/bent part and is seated on the contact portion 282.

FIG. 20 shows another exemplary embodiment of a plug-in connector element 310 for a right angle plug. The separate spring 394 has two legs with at least one latching means 319 each which interact with corresponding latching means 321 of the contact plates 372, 374. In the exemplary embodiment, the latching means 319 of the separate spring 394 have an opening or depression that is engaged by the latching means 321, which are made, for example, by embossing in one piece from the contact plates 372, 374, by latching.

On the end side, the contact plates 372, 374 form an insertion bevel 325 for the contact pin 22 of the second plug-in connector part 4. Each of the contact plates 372, 374, due to its shape, has two line contacts 323 for the contact-making contact with the contact pin 22.

At least one of the contact plates 372, 374 has a stop means 329 which is made preferably in one piece and by which the contact plates 372, 374 can be inserted in the connector element 378

WO 2011/128075

PCT/EP2011/001838

28

only up to a corresponding stop; the corresponding stop can be formed by the transition from the support element 384 to the first widened portion 373 on the inside of the connecting element 378.

It applies to all illustrated plug-in connector elements that a reliable electrical connection is made available by providing a total of four line electrical contacts. The separate springs 94, 194, 294, 394 ensure a nonpositive contact with the corresponding contact element of the assigned second plug-in connector part 4. The compensating portion 80, 280 ensures reliable contact between the contact portion 82, 282 and all four contact lines; in particular, compensation of a parallel offset or of a tilted position of the contact element with which contact is to be made is ensured. The high current carrying capacity is made available by the direct contact of the contact plates 72, 74 which have a large cross-sectional area with the contact pin 22; the required flexibility of the contact plates 72, 74 is made available by the compensating portion 80, 280 which is made separately from the contact site and the connection to the line 6.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A plug-in connector element, comprising:
parallel first and second contact plates formed of shaped, electrically conductive sheet metal strips; each of said contact plates having a connecting portion for electrical connection to a single electric line only, a contact portion for detachable electrical connection to a single mating plug-in connecting element and a compensating portion between said connecting portion and said contact portion; each said compensating portion being resiliently deflectable for resilient deflecting of the respective contact portion relative to the respective connecting portion; said connecting portion, said compensating portion and said contact portion of each said contact plate being formed in one, unitary piece from the respective sheet metal strip; and
a sleeve-shaped connecting element surrounding said connecting portions fixing said contact plates in position relative to one another in an initial state of said contact plates.
2. A plug-in connector element according to claim 1, wherein the single electric line is connected by a crimped connection of said contact plates by said connecting element.
3. A plug-in connector element according to claim 2, wherein said sleeve-shaped connecting element extends beyond a region of said crimped connection.
4. A plug-in connector element according to claim 2 or 3, wherein said sleeve-shaped connecting element comprises a support element absorbing forces occurring when the electric line is connected to said contact plates such that the forces are kept away from said contact portions.
5. A plug-in connector element according to any one of claims 1 to 4, wherein at least one of said contact plates in said compensating portion thereof has a reduced bending stiffness.

6. A plug-in connector element according to any one of claims 1 to 5, wherein at least one of said contact plates in said compensating portion thereof is bent in a meander shape.
7. A plug-in connector element according to any one of claims 1 to 6, wherein at least one of said contact plates comprises a stop in said compensating portion thereof limiting deflection of the respective contact portion relative to the respective connecting portion.
8. A plug-in connector element according to any one of claims 1 to 7, wherein at least one of said contact plates comprises a cross-sectional shape in said contact portion thereof differing from a cross-sectional shape of one contact element of the mating connecting element and having one of a V-shape and a U-shape to form two electrical line contacts with the mating connecting element.
9. A plug-in connector element according to any one of claims 1 to 8, wherein said contact plates comprise plug-in receivers in said contact portions thereof for a contact element of the mating connecting element.
10. A plug-in connector element according to any one of claims 1 to 9, wherein a separate spring biases said contact plates in a direction of direct contact-making contact with the mating connecting element.
11. A plug-in connector element according to claim 10, wherein said separate spring comprises a ring-shaped portion limiting maximum widening of said contact plates and comprises at least one spring arm projecting from said ring-shaped portion and applying a contact force.
12. A plug-in connector element according to claim 10 or 11, wherein said separate spring comprises a guide received and guided in a recess between said contact plates to clip said separate spring onto said contact plate.

13. A plug-in connector element according to any one of claims 10 to 12, wherein at least one of said contact plates comprises a stop located on a transition portion from said contact portion to said compensating portion thereof for said separate spring.

14. A plug-in connector element according to any one of claims 10 to 13, wherein at least one of said contact plates comprises a plate latch interacting and latching with a spring latch of said separate spring.

15. A plug-in connector part, comprising:

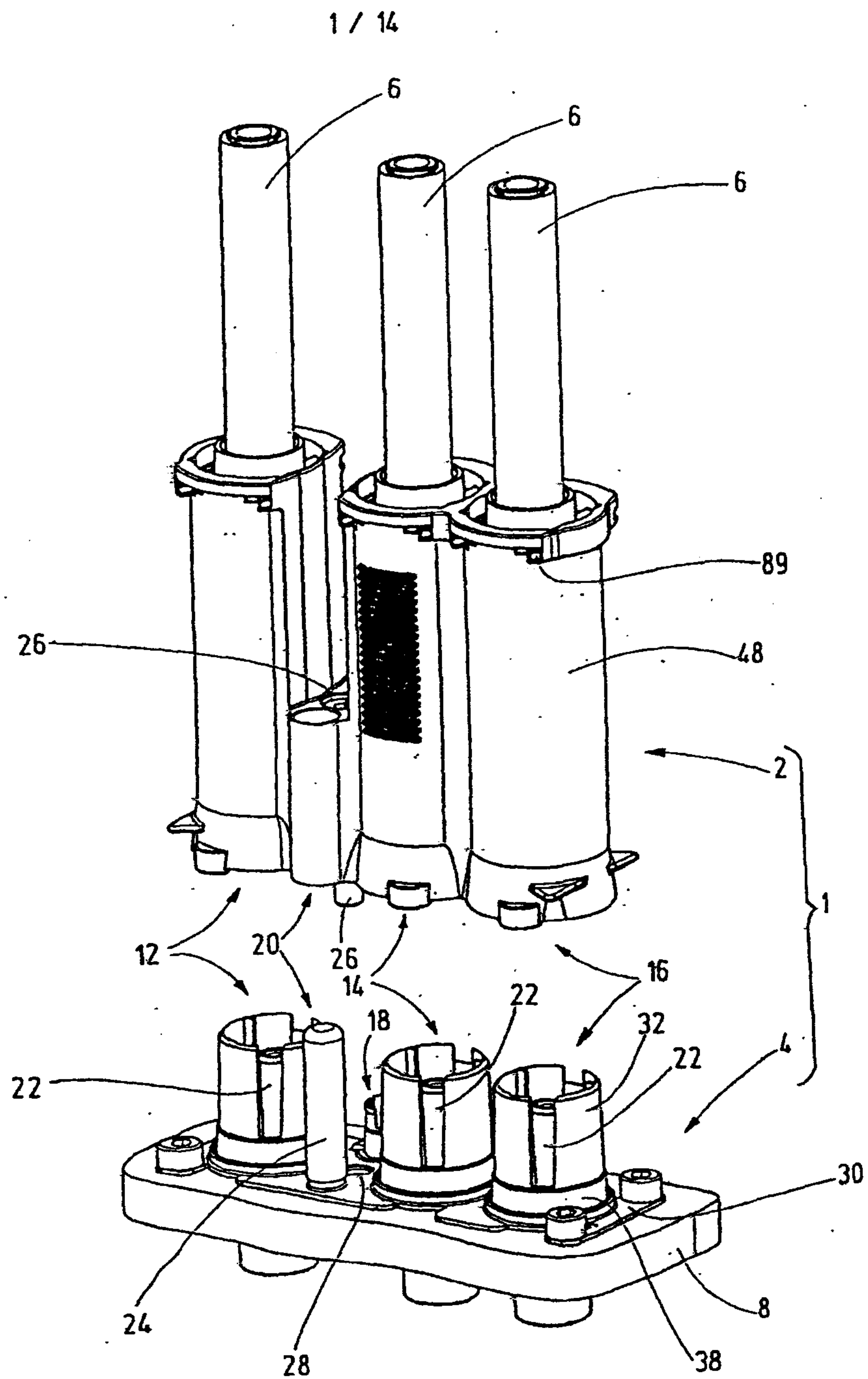
a plurality of identical plug-in connector elements located in a common housing, each of said connector elements including,

parallel first and second contact plates formed of shaped, electrically conductive sheet metal strips; each of said contact plates having a connecting portion for electrical connection to a single electric line only, a contact portion for detachable electrical connection to a single mating plug-in connecting element and a compensating portion between said connecting portion and said contact portion; each said compensating portion being resiliently deflectable for resilient deflecting of the respective contact portion relative to the respective connecting portion; said connecting portion, said compensating portion and said contact portion of each said contact plate being formed in one, unitary piece from the respective sheet metal strip; and

a sleeve-shaped connecting element surrounding said connecting portions fixing said contact plates in position relative to one another in an initial state of said contact plates.

WO 2011/128075

PCT/EP2011/001838



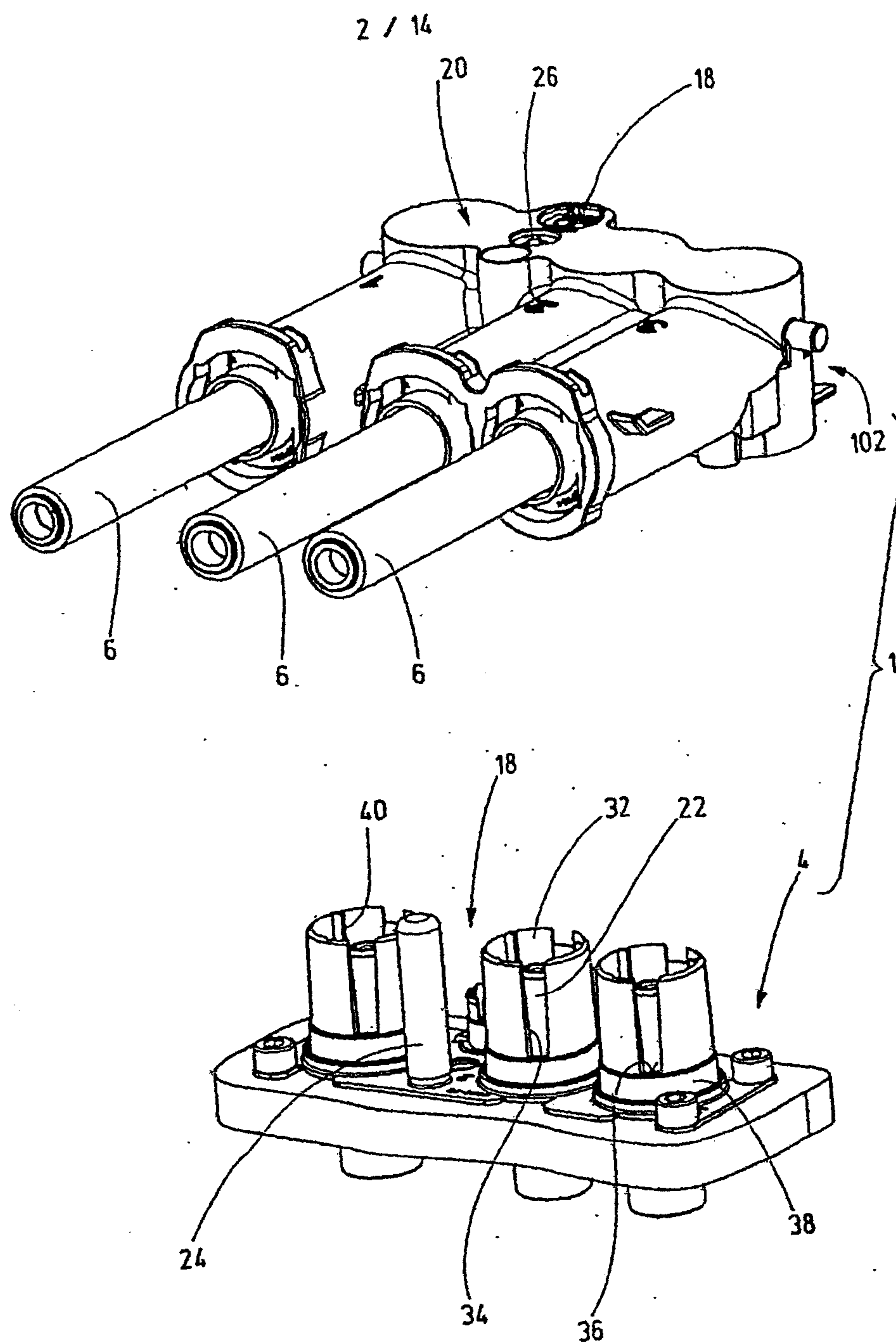
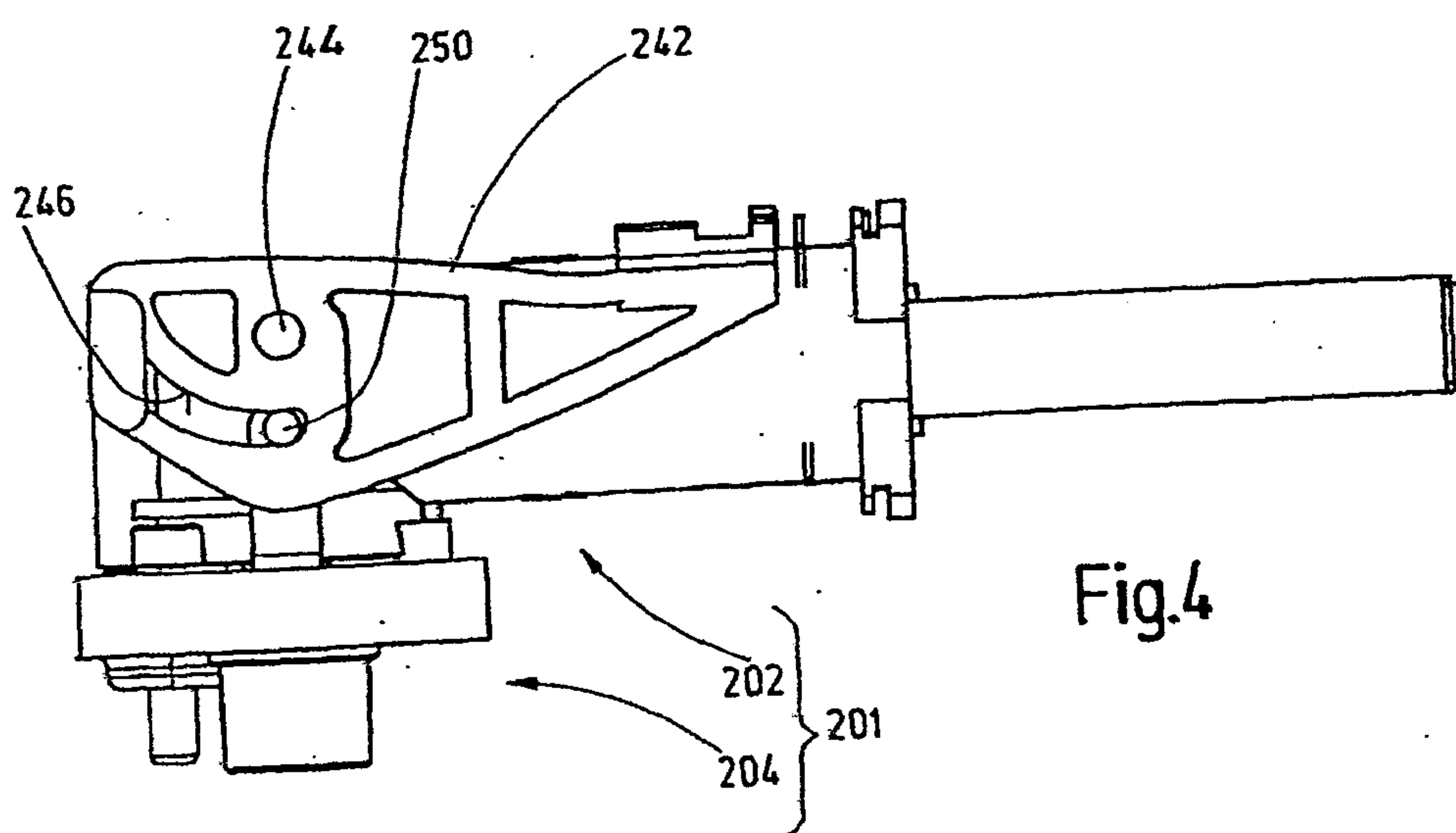
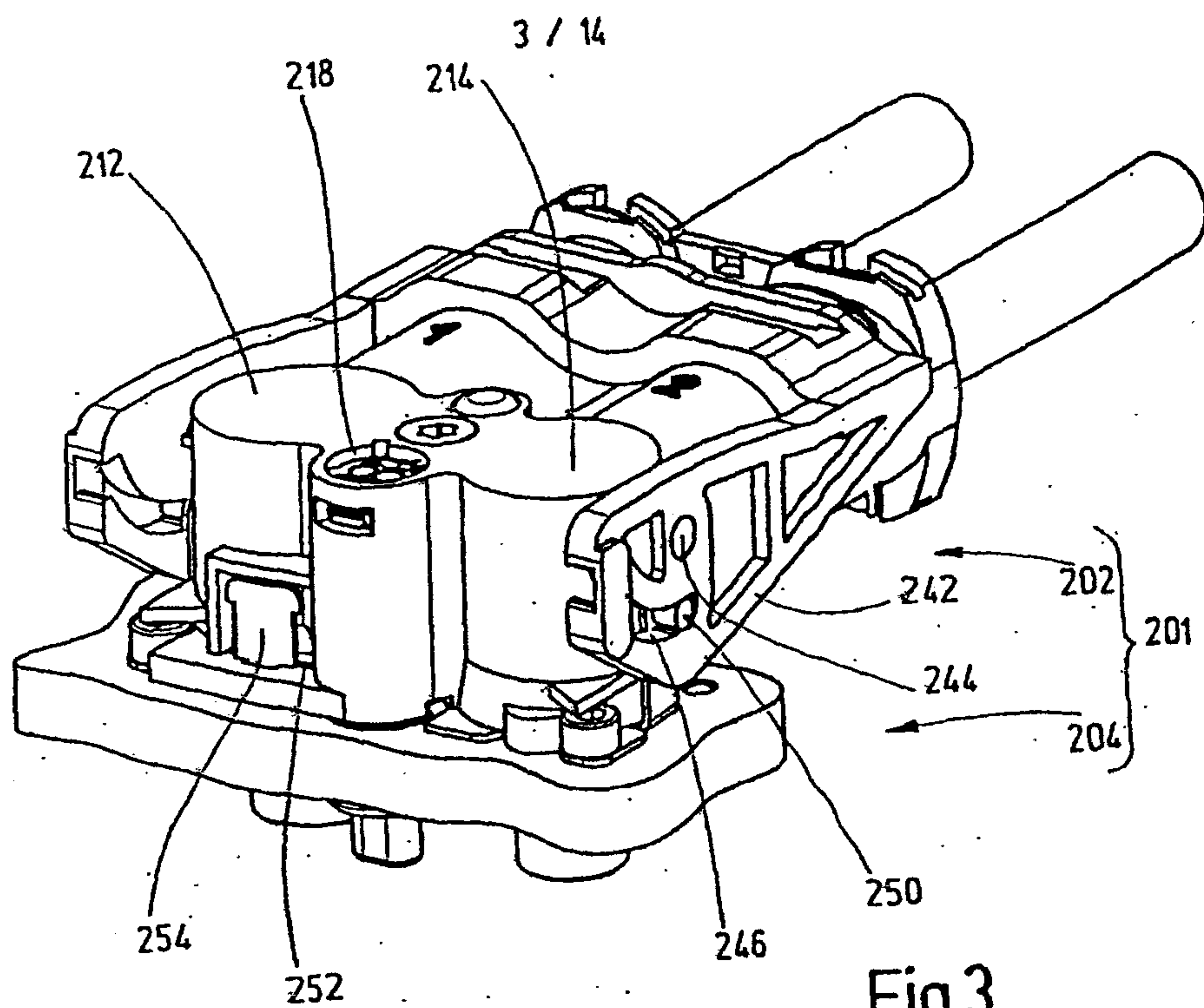


Fig.2

WO 2011/128075

PCT/EP2011/001838



WO 2011/128075

PCT/EP2011/001838

4 / 14

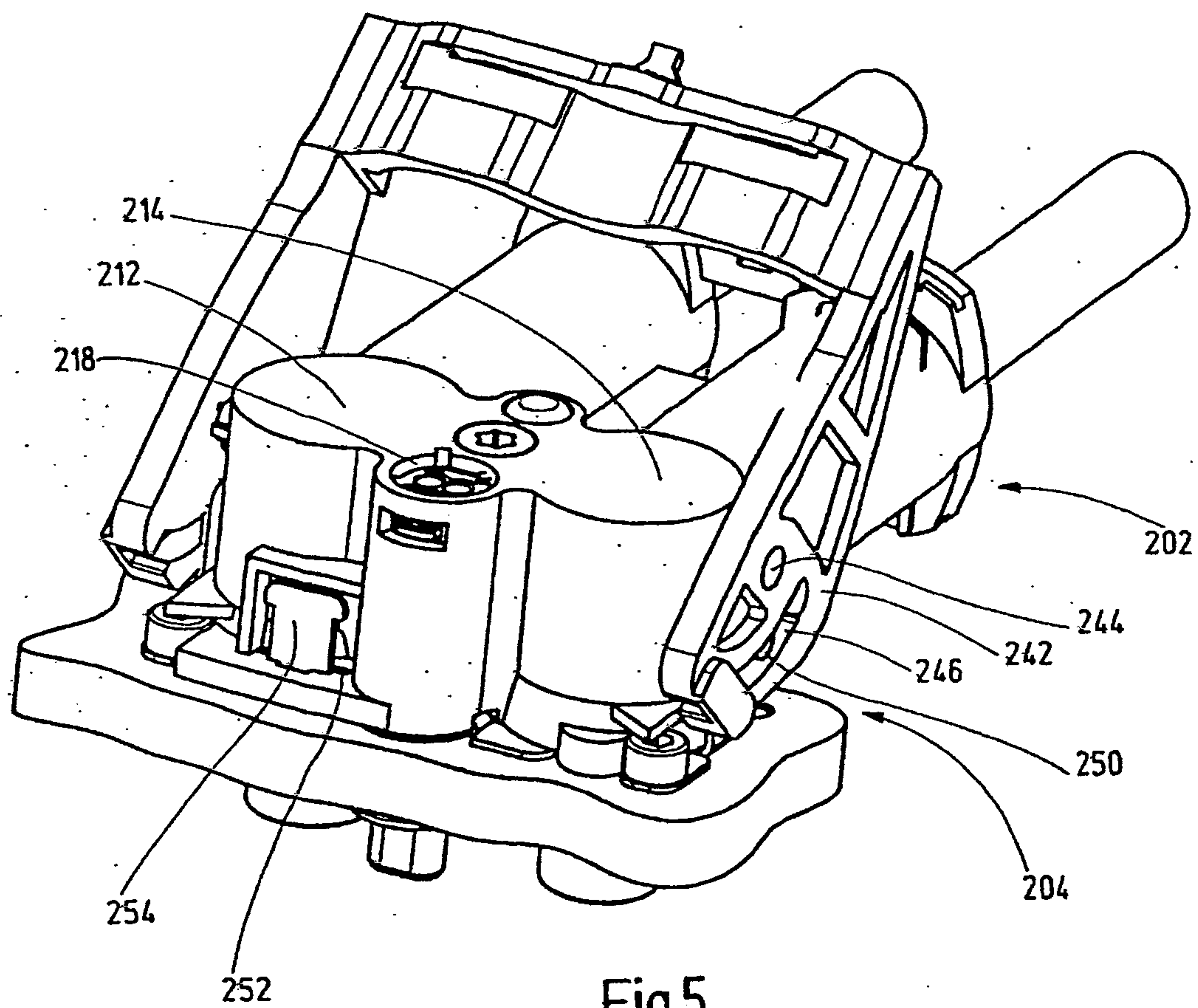


Fig.5

WO 2011/128075

PCT/EP2011/001838

5 / 14

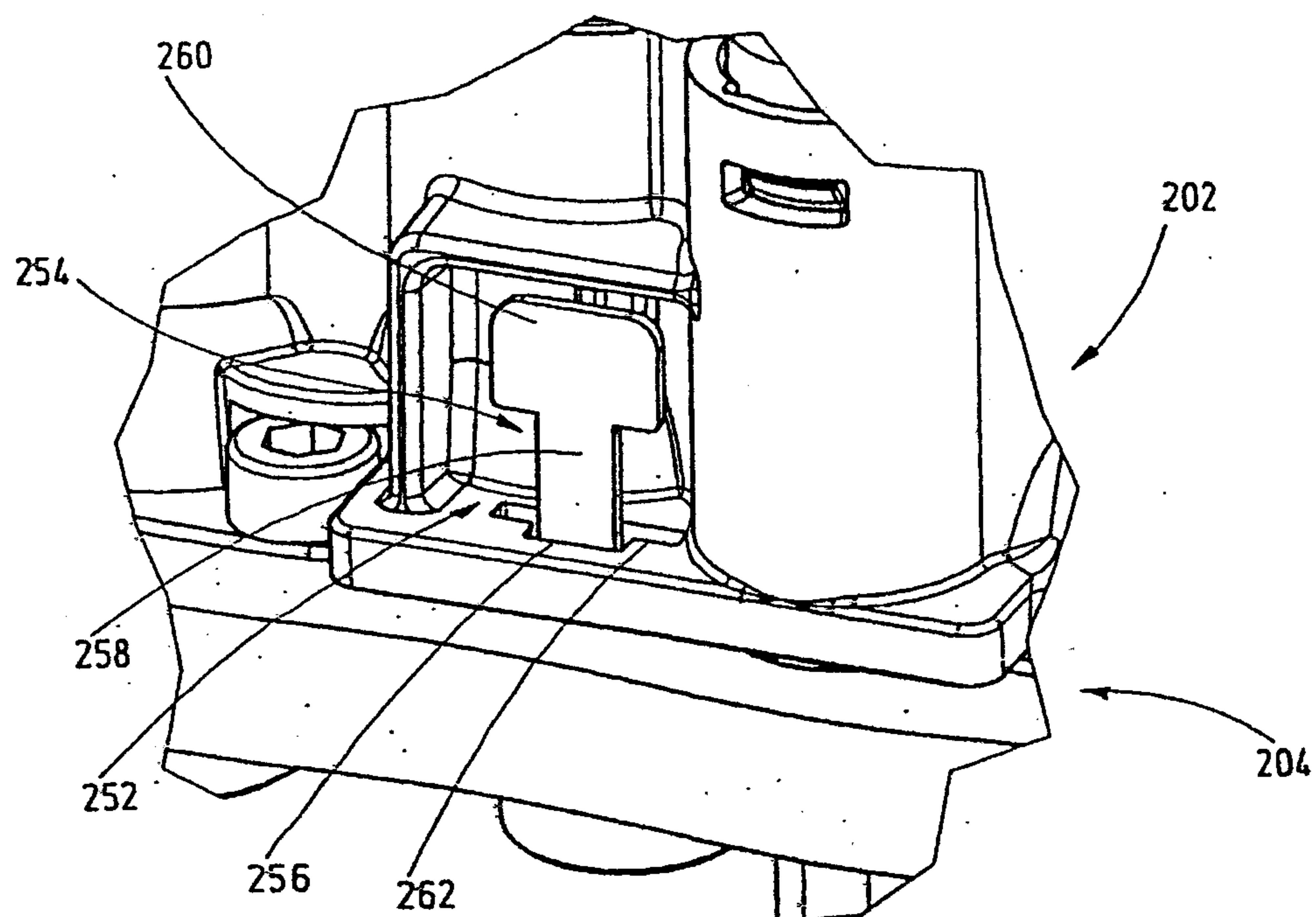


Fig. 6

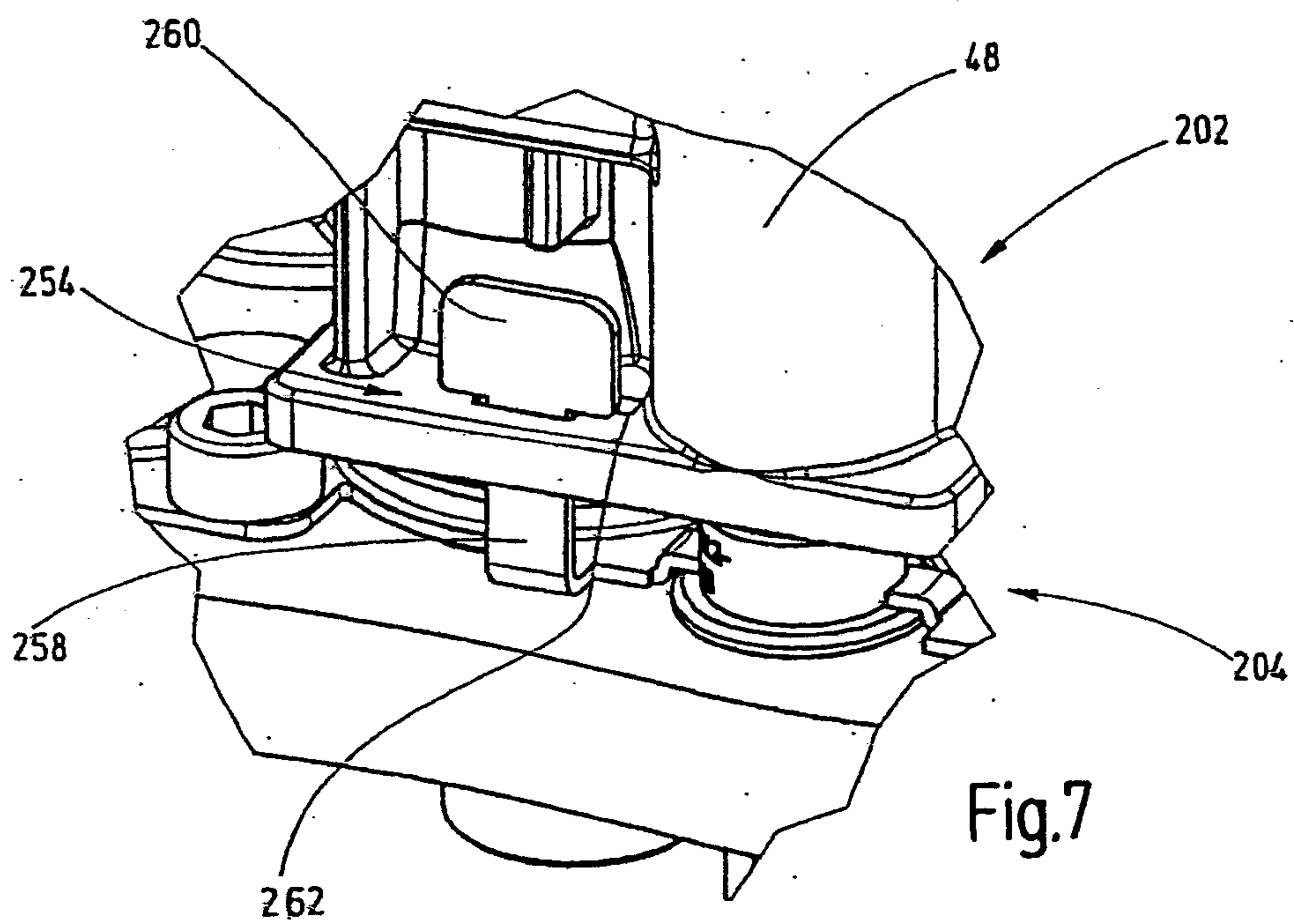
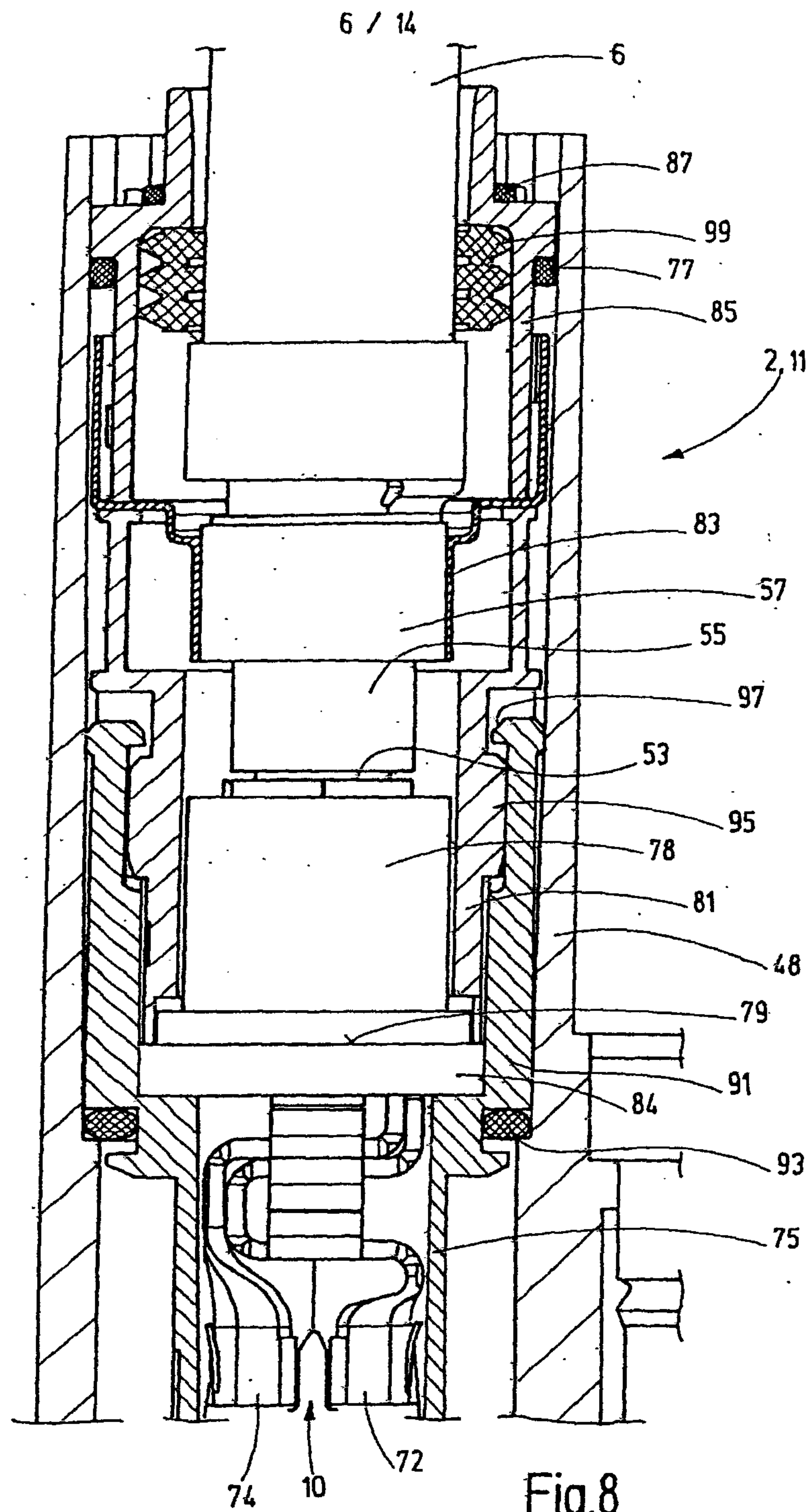


Fig. 7



WO 2011/128075

PCT/EP2011/001838

7 / 14

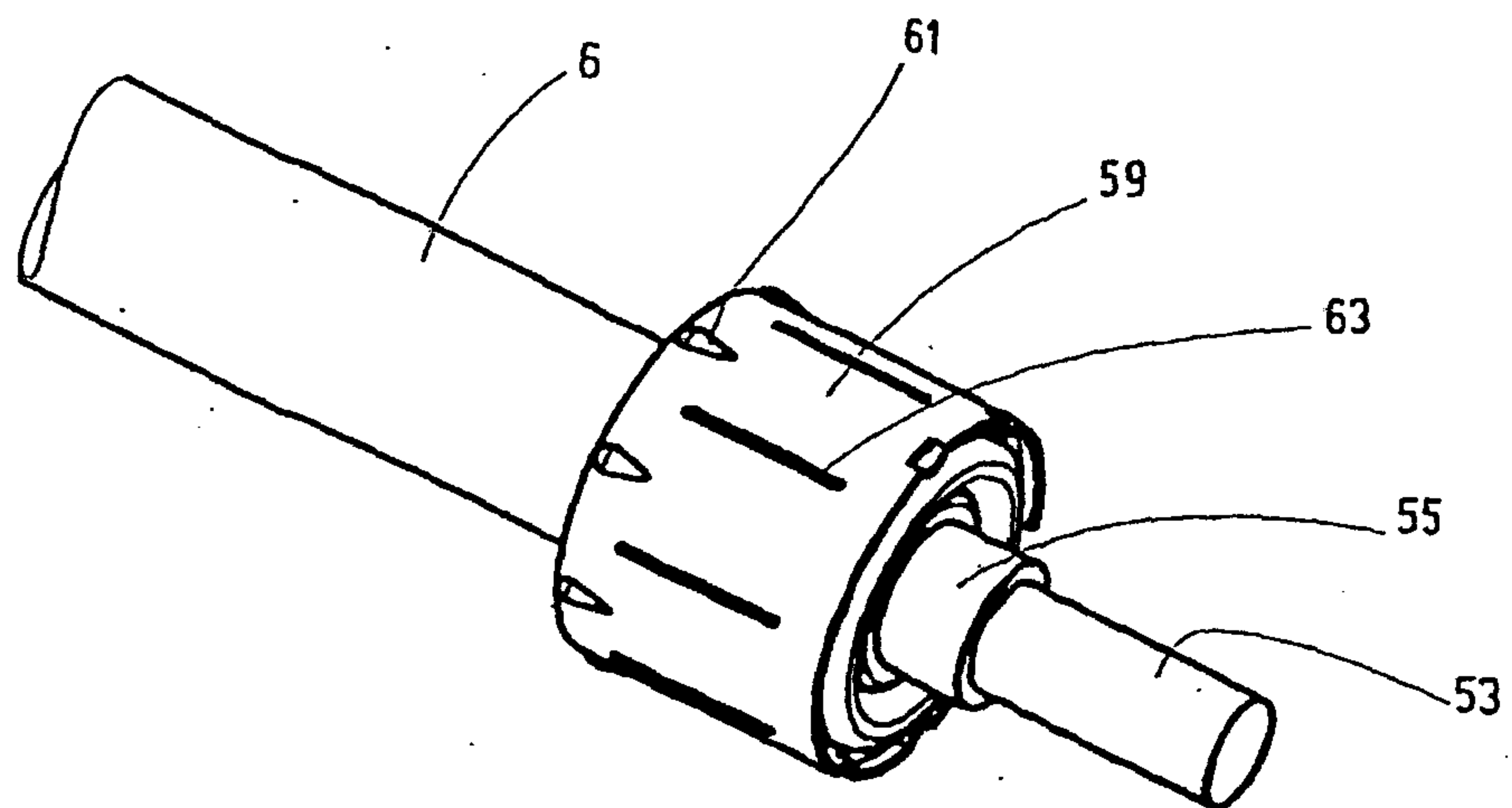


Fig.9

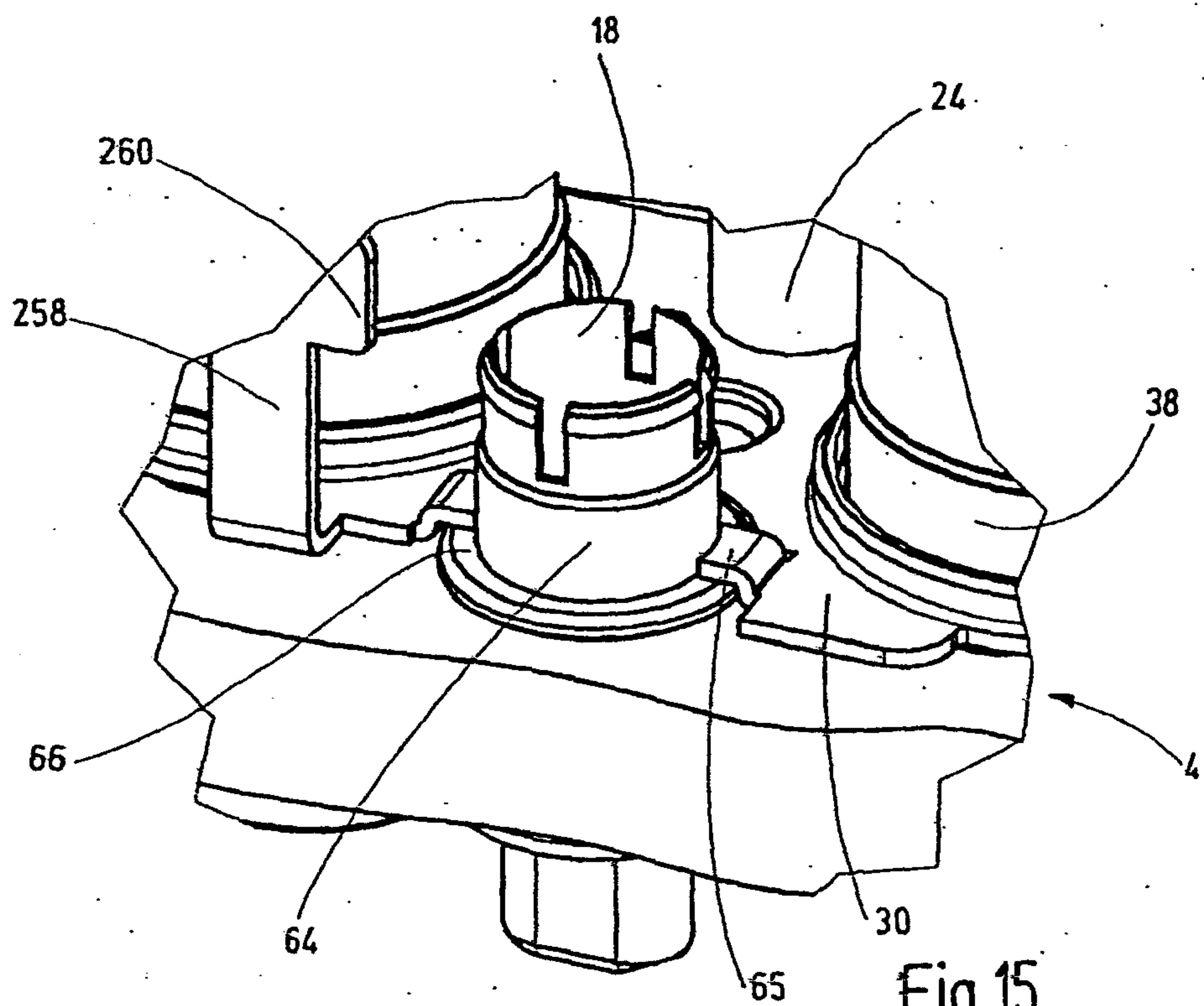
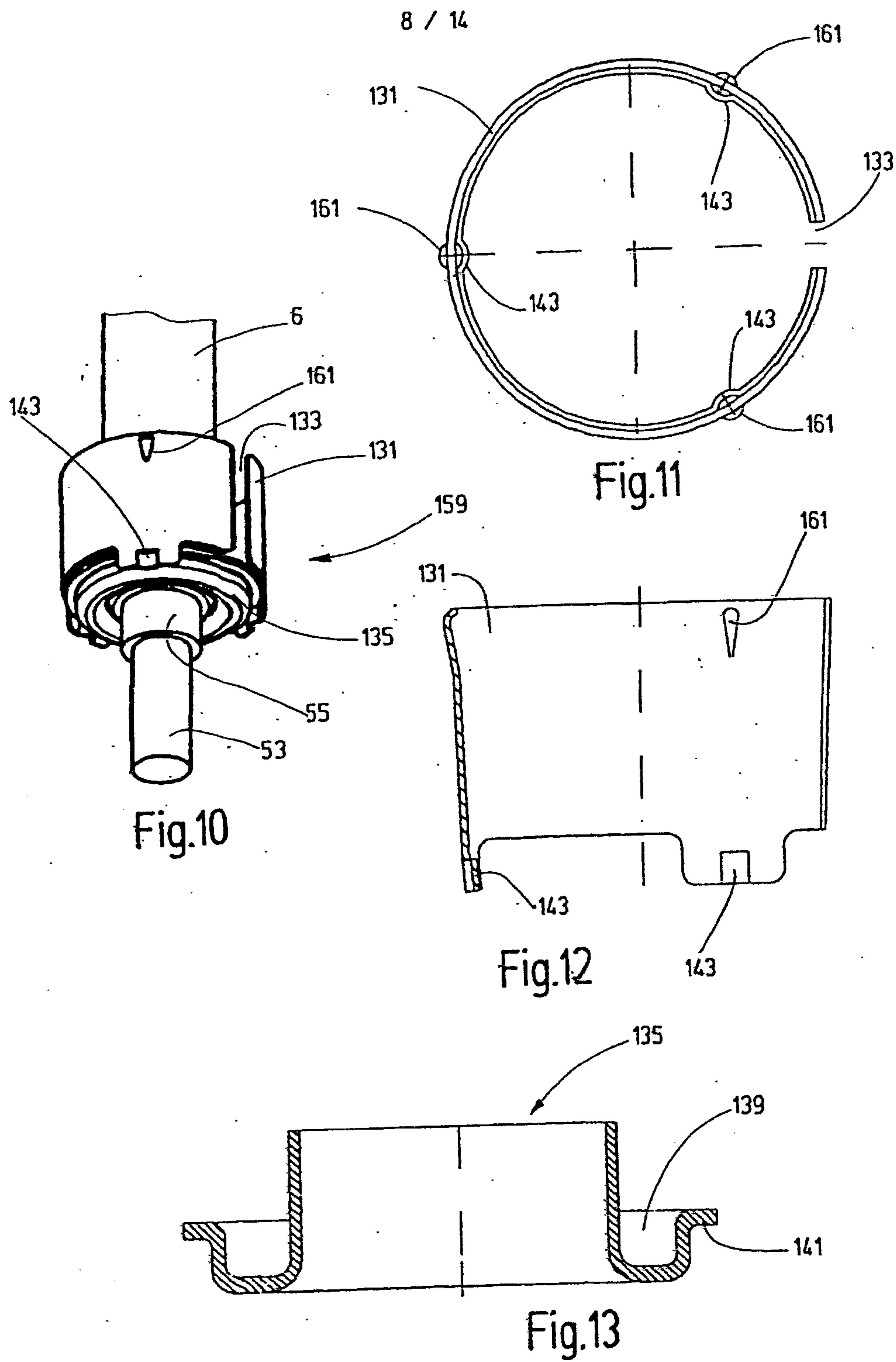


Fig.15

WO 2011/128075

PCT/EP2011/001838



9 / 14

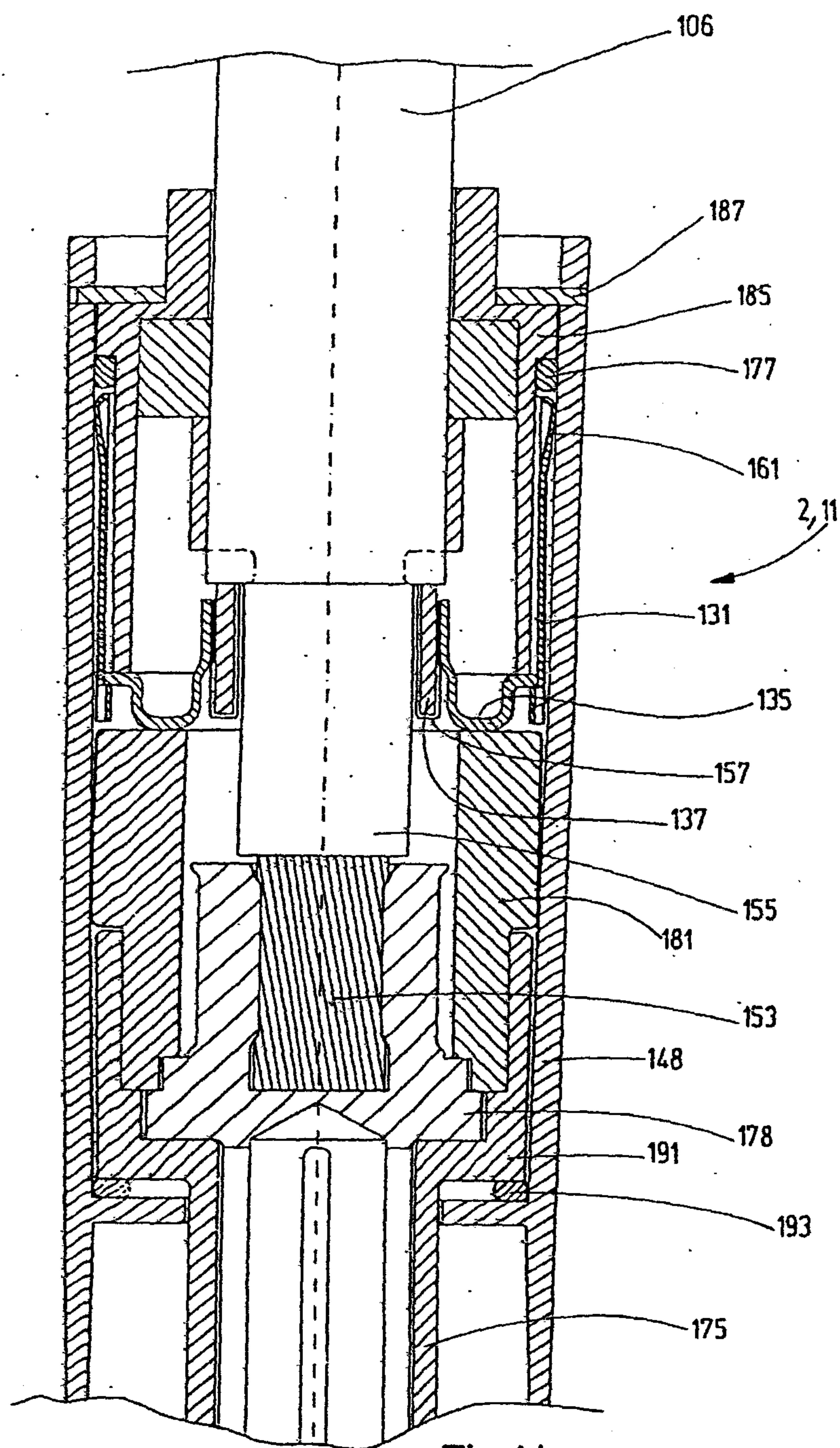
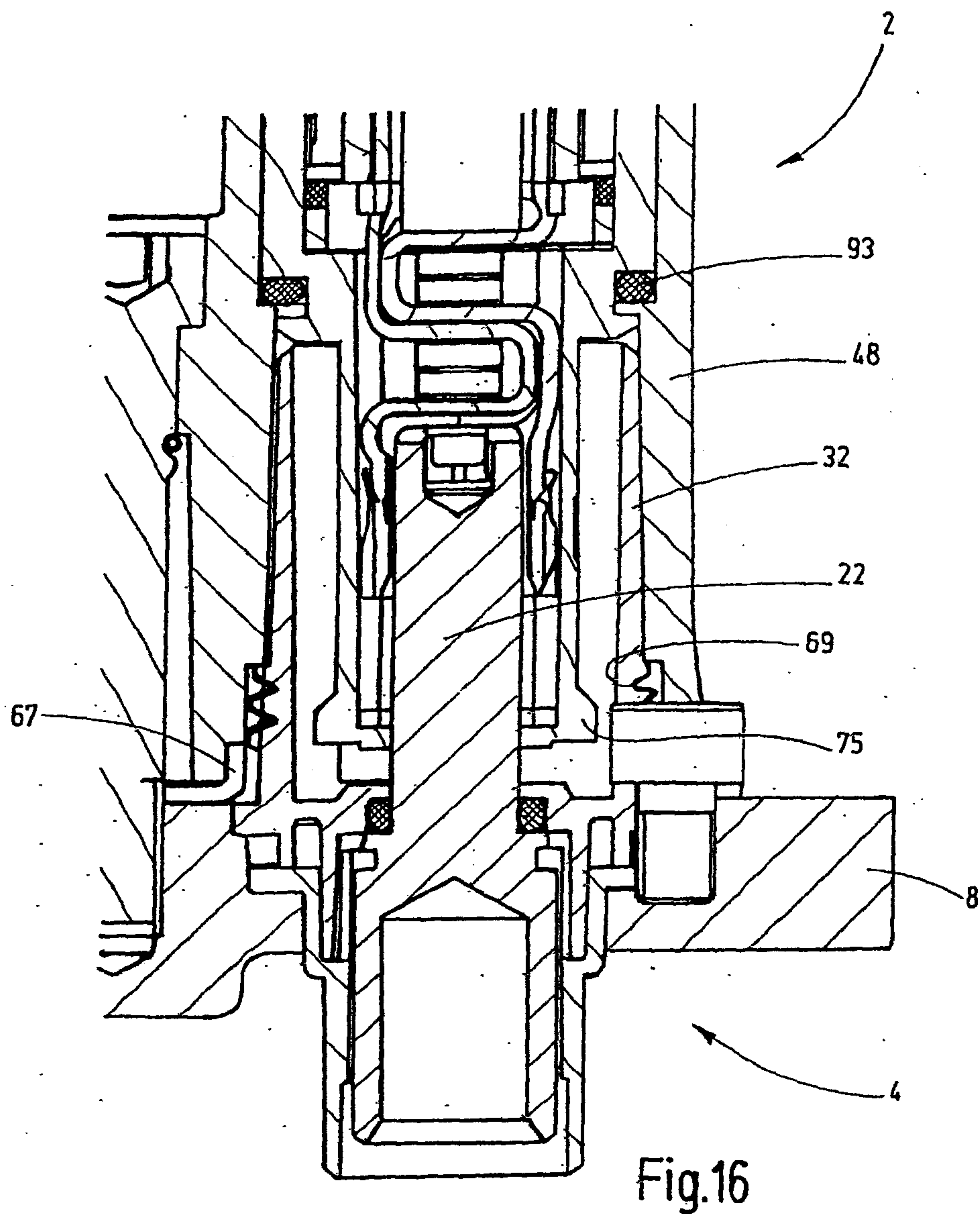


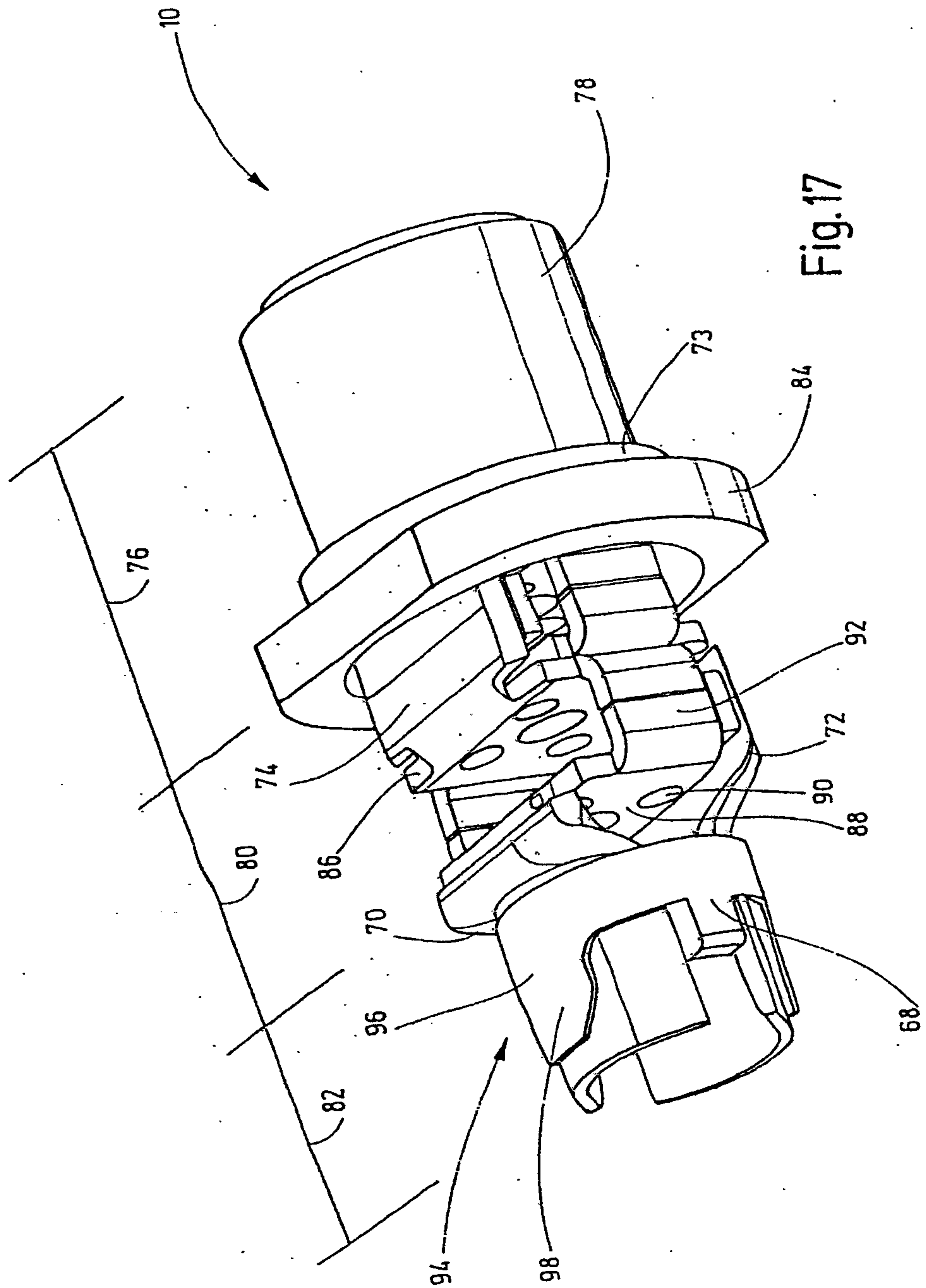
Fig.14



WO 2011/128075

PCT/EP2011/001838

11 / 14



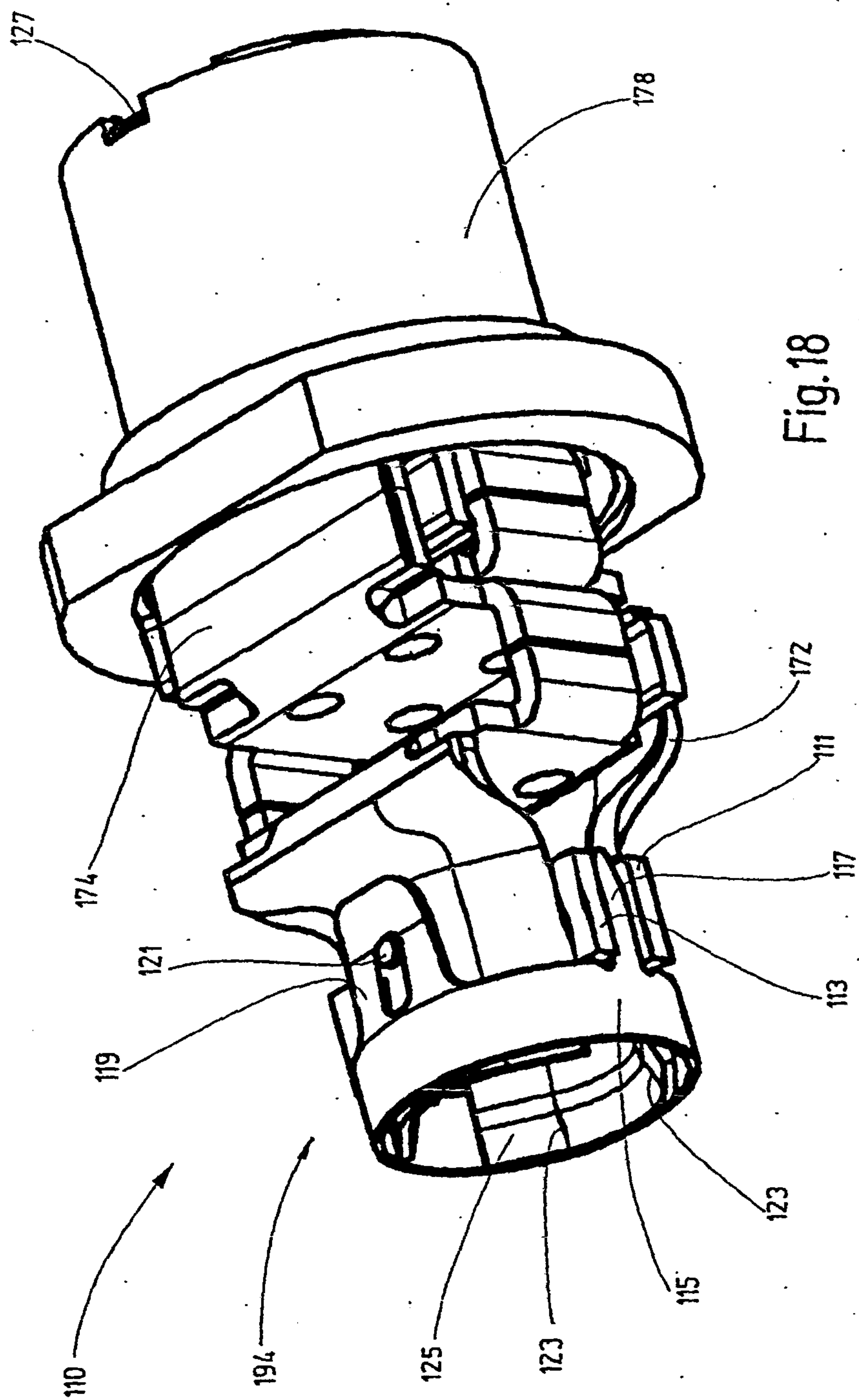
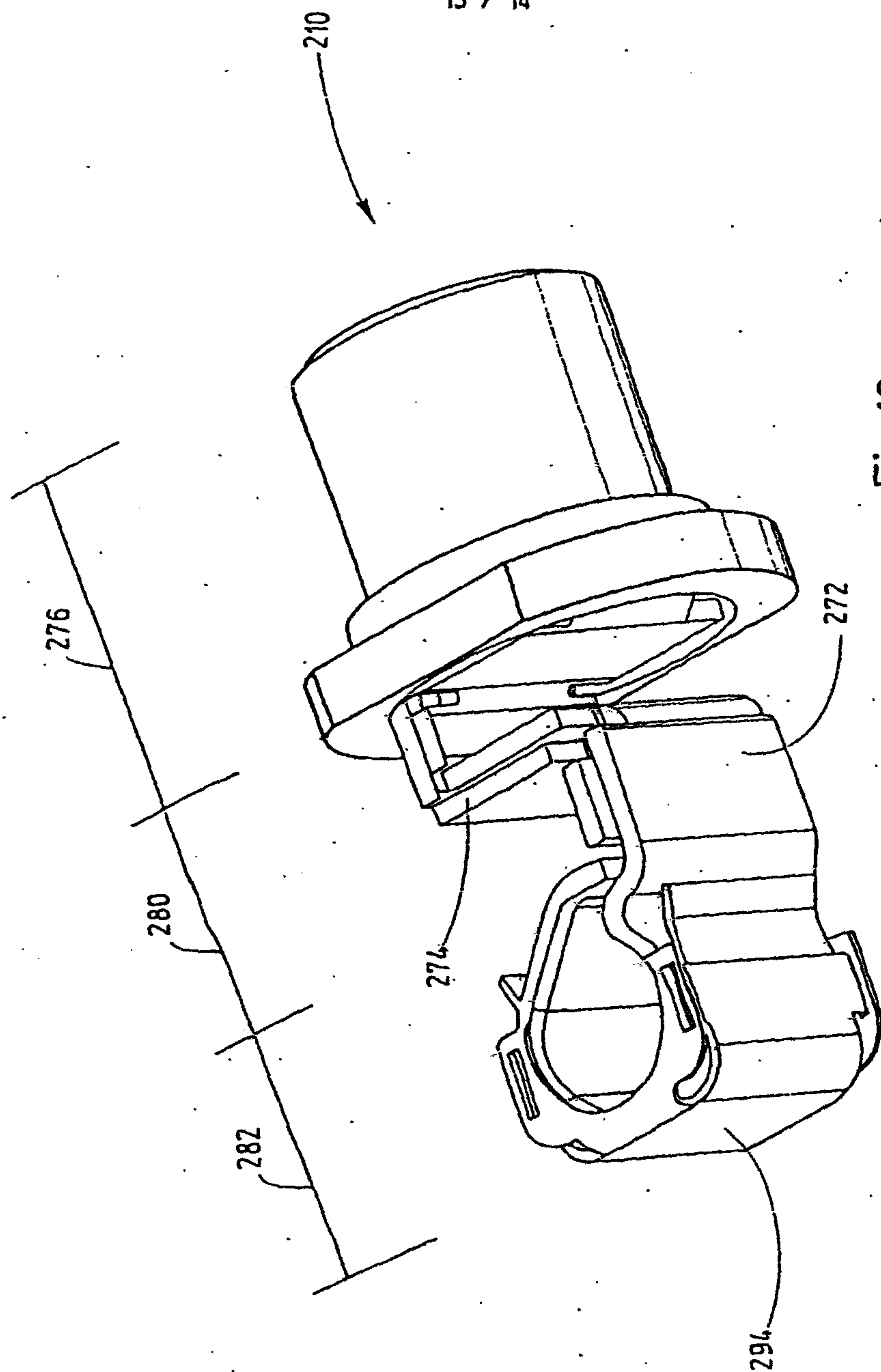


Fig. 18

WO 2011/128075

PCT/EP2011/001838

13 / 14



WO 2011/128075

PCT/EP2011/001838

14 / 14

