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- (54) **Title:** ELECTROMAGNETIC SHIELDING, AND ELECTRICAL, ELECTRONIC OR ELECTRO-OPTICAL CONNECTOR

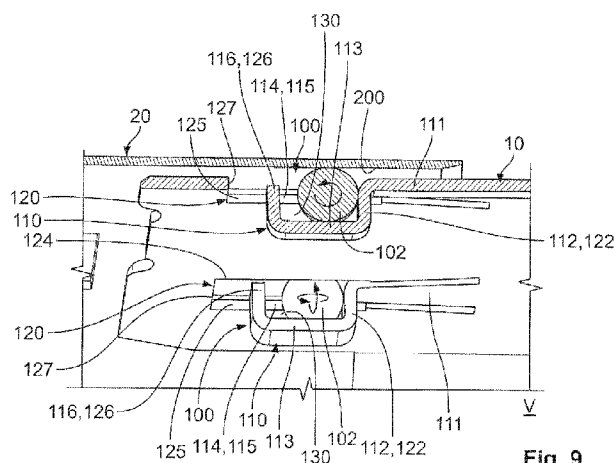


Fig. 9

- (57) **Abstract:** The invention relates to an electromagnetic shielding (10) for an electrical, electronic or electro-optical connector (1) for use in the low-voltage, medium-voltage or high-voltage and/or low-current, medium-current or high-current range, in particular for motor vehicles, with a shield contact means (100) for electrically contacting an electromagnetic shielding (20) of a mating connector (2), the shield contact means (100) having a separate electrical shield connector body (102), and for a position (V) in which the connector (1) is connected to the mating connector (2), the shielding (10) of the connector (1) is able to be connected in electrically conductive manner to the shielding (20) of the mating connector (2) by means of the shield connector body (102). Further, the invention relates to an electrical, electronic or electro-optical connector (1) for low-voltage, medium-voltage or high-voltage and/or low-current, medium-current or high-current applications, in particular for the automotive sector, the electrical, electronic or electro-optical connector (1) having an electromagnetic shielding (10) according to the invention.



Description

Electromagnetic shielding, and electrical, electronic or
5 electro-optical connector

The invention relates to an electromagnetic shielding for an
electrical, electronic or electro-optical connector for use
in the low-voltage, medium-voltage or high-voltage and/or
10 low-current, medium-current or high-current range, in
particular for motor vehicles. The electromagnetic shielding
of the connector in this case comprises a shield contact
means for electrically contacting an electromagnetic
shielding of a mating connector. Further, the invention
15 relates to an electrical, electronic or electro-optical
connector for low-voltage, medium-voltage or high-voltage
and/or low-current, medium-current or high-current
applications, in particular for the automotive sector, the
connector comprising an electromagnetic shielding according
20 to the invention.

In the electrical field (electrical power engineering,
electrical equipment, electrical engineering, electronics
etc.), a large number of electrical connection means, socket
25 connectors and/or pin connectors etc. - referred to below as
(electrical) connectors or mating connectors - are known
which serve to transmit electric currents, voltages, signals
and/or data with as large as possible a range of currents,
voltages, frequencies and/or data rates. In the low-voltage,
30 medium-voltage or high-voltage and/or low-current, medium-
current or high-current range, and in particular in the
automotive sector, such connectors briefly and/or permanently
have to ensure fault-less transmission of electric power,
signals and/or data in warm, possibly hot, dirty, damp and/or
35 chemically aggressive environments. Owing to the large range
of applications, a large number of specially configured
connectors are known.

Such connectors or their housings may be installed on an electric line, a cable, a wiring harness or an electrical device, such as on/in a housing or on a printed circuit board of electrical or electronic equipment; in the latter case, we usually speak of a (mating) connection means. If a connector is located on a line or a cable, we usually speak of a floating (plug-in) connector or plug or a coupling; if it is located on/in an electrical/electronic device, we usually speak of an integrated plug or a(n integrated) socket. Further, a mating connector is often also referred to as a plug receptacle. In the field of high-voltage and high-current engineering, in the field of the relevant connectors the term "cable fittings" is usually used.

For instance, in the automotive sector, in particular for electric and hybrid-vehicle applications, shock-proof plug-in connectors and connection heads (connectors) for low to medium power are required. For example, such 2-/3-pole connectors (see the prior art in Fig. 1) have a current-carrying capacity of up to 40 A at -40°C to 140°C for a rated voltage of approx. 1,000 V. 360° electromagnetic shielding is obligatory in this case. - Further, transmission of data is playing an increasingly important role, high demands in terms of data transmission being a decisive component of virtually every branch of industry, such as the computer industry or precisely also in the motor-vehicle industry. - There are, further, high demands in the case of cable accessories too, such as cable fittings or male cable connectors, for electric voltages above 1 kV.

In many of these applications, vibrations occur which are maintained over a comparatively long time period during operation of the connector in question. Owing to a comparatively great mass acceleration of an electrical contact pairing of two contact partners of an electrical connection in the event of vibrations, such as in particular

two electromagnetic shieldings, an inevitable relative movement of the contact partners takes place, which may result in premature failure of the electrical contact pairing. - Attempts are being made, *inter alia*, to counter
5 this problem by means of a finish of the contact surfaces involved, it being intended to make the shieldings comparatively insensitive to fretting corrosion which occurs in this case by means of a coating.

10 However, even with a reduction in the tolerances of the housing or the shieldings and additionally with an expensively finished contact surface, a harmful relative movement of the two shieldings can scarcely be avoided, or would incur considerable costs, which would no longer be
15 competitive, at the necessary low tolerances. - These problems occur in particular with shield spring tabs with contact bumps, these initially adhering to a finished contact surface in the case of vibrations in the event of a zero crossing, and, following this chronologically, if a static
20 friction force is exceeded, the relevant surfaces slide against one another, leading to fretting corrosion. As a result, the finish of the contact surface(s) in question becomes worn through chronologically before the component becomes obsolescent.

25 It is an object of the invention to devise an improved electromagnetic shielding for an electrical, electronic or electro-optical connector for use in the low-voltage, medium-voltage or high-voltage and/or low-current, medium-current or
30 high-current range, in particular for motor vehicles. Further, it is an object of the invention accordingly to make available an improved electrical, electronic or electro-optical connector. In such case, according to the invention fretting corrosion in an electrical contact region of a
35 shielding of the connector with a shielding of a mating connector should be reduced, in which case if friction occurs any proportion of static friction and/or sliding friction

should be comparatively low. In such case, fretting corrosion, optionally also for finished contact surfaces, should be reduced both on the part of the shielding of the connector and on the part of the shielding of the mating
5 connector.

The object of the invention is achieved by means of an electromagnetic shielding for an electrical, electronic or electro-optical connector for use in the low-voltage, medium-
10 voltage or high-voltage and/or low-current, medium-current or high-current range, in particular for motor vehicles, according to Claim 1; and by an electrical, electronic or electro-optical connector for low-voltage, medium-voltage or high-voltage and/or low-current, medium-current or high-
15 current applications, in particular for the automotive sector, according to Claim 10. Advantageous developments, additional features and/or advantages of the invention will become apparent from the dependent claims and the following description.

20 The electromagnetic shielding according to the invention has a shield contact means for electrically contacting an electromagnetic shielding of a mating connector, the shield contact means comprising a separate electrical shield
25 connector body. The shield contact means in this case is formed such that in/for a position in which the connector is connected to the mating connector, the shielding of the connector can be electrically connected and/or is connected in electrically conductive manner to the shielding of the
30 mating connector by means of the shield connector body. That is to say that the shield contact means has a shield connector body which is separate from the shielding, by means of which the shielding of the connector can be connected in electrically conductive manner to the shielding of the mating
35 connector. - The connector according to the invention accordingly has an electromagnetic shielding according to the invention.

In embodiments of the invention, the shield connector body is formed as a rolling and/or sliding body or as a round body with at least two-dimensional, preferably spherical,

5 rounding. Thus the shield connector body may for example be formed as a partial ellipsoid, as an ellipsoid, as a partial spherical body or as a spherical body or sphere. A preferred form of the shield connector body is that of the spherical body, i.e. for such a case the shield connector body is
10 formed as a ball contact. - According to the invention, in the event of vibrations a main proportion of friction in the position in which the connector is connected to the mating connector between the two shieldings via the shield connector body, on condition that said body is capable of rolling, is
15 accounted for by rolling friction, the coefficient of friction of which is considerably lower than that of a coefficient of static friction and also of a coefficient of sliding friction.

20 The shield contact means can be formed such that the shield connector body for/in the connection position can be provided and/or is provided at least partially between the shielding of the connector and the shielding of the mating connector. This means that an electrical series connection of the
25 shielding of the connector, the shield connector body and the shielding of the mating connector can be set up or is set up. Preferably the shield connector body is mounted on/in the shielding of the connector, the shield connector body for/in the connection position preferably being able to be pressed
30 and/or being pressed against the shielding of the mating connector. In such case, the shield contact means is preferably set up such that the shield connector body is held non-detachably on/in the shield contact means or the shielding of the connector.

35 In embodiments of the invention, the shield contact means has a bearing and a counter-bearing for the shield connector body

which hold the shield connector body reliably on/in the shielding of the connector in a position in which the connector is disconnected from the mating connector. In such case, on one hand the bearing for the shield connector body
5 is formed so as to be preferably comparatively bending-resilient and/or of elastic material, and on the other hand the counter-bearing for the shield connector body is formed so as to be preferably comparatively bending-resistant and/or of inelastic material. Further, the bearing and/or the
10 counter-bearing are preferably formed, in particular cut free, out of the shielding of the connector, or the shield contact means is partially constituted by these two bearings. Furthermore, the bearing and the counter-bearing are preferably formed such that the shield connector body is held
15 non-detachably on/in the shielding of the connector in the connection position as well.

The two bearings are preferably configured such that they constrainedly guide the shield connector body such that it -
20 apart from rotatory degrees of freedom - only still has mainly a single or substantially two translatory degrees of freedom. A respective translatory possibility of movement is restricted by a dimension or a limitation of the bearing and/or of the counter-bearing. The rotatory degrees of
25 freedom of the shield connector body depend - in the case of constant guidance by the bearing and counter-bearing - mainly on the form of the shield connector body. If it is spherical, the shield connector body has three rotatory degrees of freedom about its major axes of rotation. The two bearings
30 are further preferably matched such that they clamp the shield connector body between them in the disconnected position, so that said body cannot execute any unnecessary movements within its guide between the bearings.

35 It is possible according to the invention to omit the counter-bearing and to provide only the bearing or a spring (see below). In such a case, it may be necessary to provide

the shield connector body on/in the shield contact means only upon connecting the connector to the mating connector or only upon connecting the shielding of the connector to the shielding of the mating connector. Further, it is possible to use two bearings (see also below) and to omit the counter-bearing, or alternatively to use two counter-bearings (see also below) and to omit the bearing. When using two counter-bearings in the context of the invention, it is preferred to configure the counter-bearing which is remote from a shielding of the mating connector so as to be comparatively bending-resilient or comparatively of elastic material.

In embodiments of the invention, the shield contact means has as bearing a spring or an elastic region or an elastic component, by means of which the shield connector body can be pressed against the shielding of the mating connector. Further, the shield contact means may have as a counter-bearing a guide slot for the shield connector body, on the limitation of which slot the shield connector body can be held or is held in the disconnected position, and/or can be guided and/or is guided in/for the connection position. In such case, the shield connector body can be pressed or is pressed against the limitation of the guide slot for the shield connector body by the bearing. The guide slot or the limitation thereof in the position in which the connector is connected to the mating connector lies between the shielding of the mating connector and the bearing for the shield connector body or the spring or the elastic region or the elastic component of the shield contact means.

The bearing or spring of the shield contact means or the shielding of the connector is preferably formed as a leaf spring, a spring arm, a basket spring, a disc spring, a helical spring, a flexible spring, a torsion spring, an elastomer spring or a rubber spring. The elastic region may be a region of the shield contact means or of the shielding of the connector itself. The elastic component can be

produced from an elastic component such as an elastomer, in particular from a rubber or a silicone. - The counter-bearing or the guide slot for the shield connector body is preferably provided as a through-slot, optionally as a cutout with
5 through-slot, in the shielding of the connector. The guide slot may be of any form or any course whatsoever, a rectilinear extent being preferred. A course of the spring or the bearing is provided analogously to the course of the guide slot or the counter-bearing.

10 In embodiments of the invention, the spring is preferably formed as a substantially i-shaped, l-shaped or u-shaped leaf spring or as a substantially at least u-shaped basket spring. In such case, the leaf spring or the basket spring and the
15 preferably rectangular guide slot can cooperate such that the shield connector body can be held and/or is held on/in the shield contact means both in the disconnected position and in the connection position. - In the disconnected position, the shield connector body is preferably only still movable in a
20 longitudinal direction of the shielding of the connector or of the guide slot; ideally, the shield connector body is clamped against the counter-bearing by means of the bearing. - In the connection position, the shield connector body is preferably additionally movable in a transverse direction of
25 the shielding of the connector or of the guide slot. A freedom of movement in the longitudinal direction may in this case be considerably greater than a freedom of movement in the transverse direction.

30 In the disconnected position and the connection position, a play of the shield connector body in the longitudinal direction depends on a configuration of the guide slot or leaf spring or the basket spring. In the connection position, the play of the shield connector body in the transverse
35 direction depends on a dimension of the guide slot in the transverse direction and a diameter or a dimension of the shield connector body. Further, of course, a basket spring

may be formed such that it hinders the play of the shield connector body in the transverse direction, which can be done by means of one or two lateral basket walls. - Together, the bearing or leaf spring or the basket spring, and the counter-bearing or guide slot form a guide or a guideway (play) of the shield connector body in the shield contact means. This guide may be rectilinear and/or curved; its diameter possibly varies slightly, in the region of not quite a diameter of the shield connector body.

In embodiments of the invention, in the disconnected position the shield connector body protrudes out of the guide slot with a section. Upon connecting the connector to the mating connector, this section of the shield connector body can be contacted/is contacted mechanically and electrically by the shielding of the mating connector, in particular an inner contact surface of this shielding. In such case, the shield connector body is pressed inwards into the connector or the shielding of the connector, the bearing or the spring pressing the shield connector body against the contact surface of the shielding of the mating connector. The counter-bearing for the shield connector body in this case preferably remains intact, with an additional play for the shield connector body being produced however in the transverse direction of the guide slot; the play of the shield connector body remains in the longitudinal direction of the guide slot.

It is of course possible to reverse the kinematics, i.e. to arrange, e.g. to transpose, the bearing and counter-bearing of the shield contact means of the connector such that the said section of the shield connector body upon connection of the connector to the mating connector is contactable and/or contacted mechanically and electrically externally on the shielding of the mating connector. The shieldings of the connector and the mating connector also have to be formed accordingly, i.e. the shielding of the connector can be

plugged partially onto the shielding of the mating connector.
- The shielding of the connector and/or the shielding of the mating connector may be formed as a shield plate.

Furthermore, the shielding of the connector and/of the mating
5 connector may have a spring tab, optionally with contact bump, for centring the shieldings.

In embodiments of the invention, the shielding of the connector and/or of the mating connector is formed in one
10 part - i.e. the relevant individual parts thereof can be separated simply by hand or by means of a tool and without damaging its relevant individual parts -, in one piece - i.e. the relevant individual parts thereof cannot be separated simply by hand or by means of a tool and possibly not without
15 damaging its relevant individual parts -, in one piece in terms of material - i.e. the relevant individual parts thereof (if there are components) are secured to each other by a material-formed joint - or integrally - i.e. there is only a single component which can be split virtually only by
20 destroying it. The bearing and/or the counter-bearing of the shield connector body is preferably formed in one piece in terms of material or integrally with the shielding of the connector.

25 In accordance with the rolling contacting - electrical transmission of contact by means of preferably a spherical body - according to the invention of two shieldings, a considerable improvement in fretting corrosion between the shieldings under vibrational movements is yielded, since any
30 coefficient of friction which occurs is reduced effectively. Wearing-through of a contact surface, in particular a finished contact surface, can be permanently avoided in this case. This relates both to the shielding of a connector and to the shielding of a mating connector. In embodiments of the
35 invention, in this case it is possible to dispense with narrow tolerances and/or finishing of the contact surfaces involved. Further, according to the invention contact bumps

are obsolete, which means that no tearing-open of a surface in the region of the contact bump can occur either.

The invention will be explained in greater detail below using
5 examples of embodiment with reference to the appended drawings. The figures (Fig.) of the drawings depict:

- Fig. 1 a three-dimensional view of an electrical connector
in accordance with the prior art for applications in
10 the electric and hybrid vehicle field;
- Fig. 2 a perspective view of an embodiment of an
electromagnetic shielding according to the invention
for an electrical connector according to the
invention;
- 15 Fig. 3 a lateral perspective view of the shielding of Fig. 1
with an electrical shield contact means according to
the invention;
- Fig. 4 a sectional perspective view through the shield
contact means in a position in which the connector is
20 disconnected from a mating connector;
- Fig. 5 a view analogous to Fig. 4, but for a position in
which the connector according to the invention is
connected to the mating connector;
- Fig. 6 a perspective view from the rear of the shielding of
25 the connector before it is fitted together with a
shielding of the mating connector (disconnected
position);
- Fig. 7 a view analogous to Fig. 6, which shows the
shieldings of the connector and of the mating
30 connector upon fitting them together (transition from
the disconnected position into a connection
position);
- Fig. 8 a view again analogous to Fig. 6, in which the
shielding of the connector is illustrated fitted
35 together with the shielding of the mating connector
(connection position); and

Fig. 9 a three-dimensional illustration, sectioned in the region of a shield contact means, of the connection position of the two shieldings.

5 The invention will be explained in greater detail below with reference to an application (see prior art in Fig. 1) and with reference to an embodiment (see Figs. 2 to 9). The principle according to the invention - electrical shield contacting which is improved with regard to fretting
10 corrosion based on rolling and/or sliding friction by means of an additional body - is of course not restricted to this form of application. Rather, the invention is of basal nature, so it can be applied to all electrical contactings of electromagnetic shieldings of electrical connectors (see
15 above and cf. list of reference numerals). - Below, the designations of a connector 1 and a mating connector 2, and of a bearing 110 and a counter-bearing 120, are interchangeable, also individually.

20 Fig. 1 shows a high-voltage electrical connector 1 in accordance with the prior art for low to medium power for automotive applications with a conventional electromagnetic shielding 40. The shielding 40 has a conventional shield contact tab 140 with a shield contact bump 141. In a position
25 in which the high-voltage connector 1 is connected to a mating connector formed complementarily to the connector 1 (cf. Fig. 8), the shield contact bump 141 is seated by adhesion on an electromagnetic shielding of the mating connector. In the event of vibrations, a static friction
30 force of the shield contact bump 141 on the shielding of the mating connector is exceeded again and again, comparatively great, progressive fretting corrosion occurs, and in a chronological sequence an optionally finished contact surface of the shield contact bump 141 becomes worn through.

35

The invention overcomes this problem by very largely avoiding static friction, or converting static friction which does

occur in the event of vibration comparatively quickly into sliding friction without comparatively large proportions of fretting corrosion, or preferably quickly into rolling friction. This takes place according to the invention (Figs.

5 2 to 9) by electrical contacting, based on a as a shield connector body 102 or shield contact body 102, of an electromagnetic shielding 10 of a connector 1 according to the invention with an electromagnetic shielding 20 of a mating connector 2. The shield connector body 102 in this
10 case is provided as a separate component. The shield connector body 102 may in this case be formed e.g. as a rolling and/or sliding body, a round body with at least two-dimensional, preferably spherical, rounding, a (partially) spherical body, a partial sphere(/spherical body), a sphere
15 section, e.g. as a hemisphere(/hemispherical body), a partial ellipsoid, an ellipsoid, a barrel-type roller, a cylindrical roller, a tapered roller or preferably as a sphere or a spherical body - i.e. as a ball contact.

20 According to the invention, a shield contact means 100 for electrical contacting of the shielding 10 of the connector 1 with the shielding 20 of the mating connector 2 has the shield connector body 102 in such a way that the latter can be provided between the two shieldings 10, 20 (see Figs. 6 to
25 8 and 9). In such case, the shield contact means 100 is formed such that the shield connector body 102 in a connection position V, contact position V or insertion position V of the connector 1 with the mating connector 2 or of the shielding 10 with the shielding 20 (see Figs. 8 and 9)
30 can move in a guide 130 or a guideway 130 between the two shieldings 10, 20. The shield contact means 100 in this case is provided at least on one of the two shieldings 10, 20 or is partially constituted by the shielding 10, 20 in question (bearing 110 and counter-bearing 120, see below); in the
35 present case, this is the shielding 10 of the connector 1.

The form of the movement of the shield connector body 102 depends substantially on the form of the shield connector body 102. Below, the point of departure is a spherical shield connector body 102 which has two translatory (see arrows in Fig. 8), and with respect to its major axes of rotation three rotatory (see arrows in Fig. 9), degrees of freedom within the guideway 130. Preferably, in this case the shield connector body 102 rolls between the two shieldings 10, 20; sliding of the shield connector body 102 may of course occur.

- If a different body, such as for example a partial body, e.g. a hemisphere, is used, then it is usual for the shield connector body 102 to slide within the guideway 130. In such a case, the partial body in the connection position V slides both on the bearing 110 and relative to the shielding 20 (cf. below).

The possibilities of movement or a play of the shield connector body 102 depend on the configuration of the guideway 130. Preferably this guideway 130 which is formed by the shield contact means 100 is rectilinear and lies preferably parallel to the shieldings 10, 20, which preferably have parallel walls in a relevant section. In such case it is preferred for the guideway 130 to be arranged partially between the two shieldings 10, 20 (cf. below a section 103 of the shield connector body 102 which protrudes from the counter-bearing 120). - Another form of the guideway 130, e.g. a guideway 130 with a curve, can of course optionally be used in sections. Care merely needs to be taken that the shield connector body 102, in all its possible positions, in the connection position V simultaneously electrically contacts both the shielding 10 and the shielding 20 or electrically connects the two shieldings 10, 20 at any time.

Preferably, the guideway 130 of the shield connector body 102 extends in a longitudinal direction L and a transverse direction Q of the connector 1, the longitudinal direction L

preferably also being a direction of joining, of connection or of plugging of the connector 1 onto/into the mating connector 2. The shield connector body 102 is preferably movable in a vertical direction H of the connector 1 only upon connecting the connector 1 to the mating connector 2 (disconnected position T => connection position V, see Figs. 6 to 8 and below). The longitudinal direction L, transverse direction Q and vertical direction H are drawn in only in Fig. 1. - The guideway 130 of the shield connector body 102 in the shield contact means 100 or on the shielding 10 is formed in the present case by means of a bearing 110 and a counter-bearing 120 of the shield contact means 100. In accordance with the embodiment illustrated, the shield connector body 102 can move comparatively extensively within the guideway 130 in the longitudinal direction L (see Figs. 3 and 9) and merely rather restrictively in the transverse direction Q thereto (see Fig. 5).

The guideway 130 in the present case is formed by means of two bearings 110, 120, the bearing 110 and the counter-bearing 120, the two bearings 110, 120 being associated with the shield contact means 100. - The bearing 110 may be formed e.g. as a spring, a leaf spring, an i-shaped, l-shaped or u-shaped spring arm, an at least u-shaped basket spring, a disc spring, a helical spring, a flexible spring, a torsion spring, etc. Further, the bearing 120 may be formed as an elastic component, e.g. having an elastomer, such as a rubber or a silicone etc. - The counter-bearing 120 is preferably formed as a guide slot 120 for the shield connector body 102, optionally as a partial through-slot 120, in the shielding 10. According to the invention, the bearing 110, in a position T in which the connector 1 is disconnected from the mating connector 2 (see Figs. 2 to 4 and 6), presses the shield connector body 102 against the counter-bearing 120, and in the connection position V presses the shield connector body 102 internally against a contact surface 200 of the mating connector 2 (see Figs. 5, 8 and 9).

In the present case, the bearing 110 is formed as a u-shaped leaf spring 110 or as an at least u-shaped basket spring 110 (see in particular Fig. 9). The leaf spring 110 or basket spring 110 is joined to the shielding 10, preferably in one piece in terms of material or integrally, via a base spring arm 111, the bearing 110 being cut free from the shielding 10 as far as the attachment point. In such case, the leaf spring 110 is cut free on three sides. In the direction of its free longitudinal end, the leaf spring 110 or basket spring 110 after the base spring arm 111 has a rear wall 112 or basket wall 112, a base 113 or basket base 113 and a front wall 116 or basket wall 116. A function of the front wall 116 or basket wall 116 can be taken over by a front end 127 of the counter-bearing 120 or the guide slot 120 (see below). Likewise, a function of the rear wall 112 or basket wall 112 can be taken over by a rear end of the counter-bearing 120 or the guide slot 120.

Preferably the base spring arm 111 lies in a plane of the shielding 10, the rear wall 112 or basket wall 112 extending starting from the base spring arm 111 inwards into the shielding 10. In such case, a preferably right-angle is provided between the base spring arm 111 and the rear wall 112 or basket wall 112. Starting from the rear wall 112 or basket wall 112, the base 113 or basket base 113 extends away preferably at a right-angle, the base 113 or basket base 113 being arranged preferably parallel to a relevant side of the shielding 10. At an end of the base 113 or basket base 113 facing a free end of the leaf spring 110, the front wall 116 or basket wall 116 extends preferably again at a right-angle away from the base 113 or basket base 113 in the direction of an inner side of the shielding 10. The front wall 116 or basket wall 116 preferably ends within the guide slot 120.

When sizing the front wall 116 or basket wall 116, care needs to be taken that the shield connector body 102 cannot drop

out of the guideway 130, which can be achieved even by a comparatively short front wall 116 or basket wall 116. This applies of course to the entire bearing 110 and counter-bearing 120. - Preferably the bearing 110 is cut or punched out of the shielding 10 such that once the bearing 110, which in this case is preferably configured as a leaf spring 110 or basket spring 110, has been bent into shape the counter-bearing 120 remains as a preferably rectangular slot in the shielding 10 (see Figs. 2, 6 and 9). Owing to the bending into shape of the bearing 110, the counter-bearing 120 is formed somewhat longer than the bearing 110 (cf. Figs. 6 and 9); a play which is produced can however be covered by the shielding 20 when the two shieldings 10, 20 are fitted together (see Figs. 8 and 9), which means that any worsening effect on the quality of a shield can again be compensated for.

The counter-bearing 120 for the shield connector body 102, which is preferably formed as a guide slot 120, has a rear limitation 122 which can optionally be taken over by the rear wall 112 or basket wall 112 or coincides therewith. The situation is the same with a front limitation 126 of the counter-bearing 120, which can optionally be taken over by the front wall 116 or basket wall 116 or coincides therewith. A front end 127 of the counter-bearing 120 or of the guide slot 120 may also be located further away from the front wall 116 or basket wall 116 (cf. above, see Fig. 9). Furthermore, the counter-bearing 120 has lateral limitations 124, 125 (see Figs. 4 and 5). - Preferably the substantially rectangular guide slot 120 for the shield connector body 102 is formed by the rear wall 112 or basket wall 112 of the bearing 110 and the lateral limitations 124, 125 and the front end 127 of the counter-bearing 120, the guide slot 120 for the shield connector body 102 being effective merely as far as the front wall 116 or basket wall 116 of the bearing 110.

The shield connector body 102 can move back and forth in the longitudinal direction L on the base 113 or basket base 113 between the rear wall 112, (122) and the front wall 116 or basket wall 116 (see in particular Figs. 8 and 9), which
5 forms part of the guideway 130. Further, the shield connector body 102 in the position V in which the connector 1 is connected to the mating connector 2 can move in the transverse direction Q thereto between the lateral limitations 124, 125 of the guide slot 120 (see in particular
10 Figs. 5 and 8), which in turn forms part of the guideway 130; this should become clearer from the following embodiments. The shield connector body 102 which is preferably formed as a spherical body 102 can therefore move in the connection position V in the longitudinal direction L and in the
15 transverse direction Q within the guideway 130, said body mechanically and electrically contacting both the shielding 10 of the connector 1 and the shielding 20 of the mating connector 2. In such case, the two shieldings 10, 20 are electrically connected in series via the shield connector
20 body 102.

This happens as follows. The counter-bearing 120 or the rectangular guide slot 120 is of such dimensions in its transverse direction Q that in the position T in which the
25 connector 1 and mating connector 2 are disconnected a section 103 of the shield connector body 102 protrudes out of the guide slot 120 which is configured as a through-cutout 120 (see in particular Fig. 4). For this, the dimensions of the guide slot 120 and of the shield connector body 102 are
30 selected correspondingly, in particular a diameter of the guide slot 120 in the transverse direction Q is not greater than a diameter of the shield connector body 102. Three sites (three-point fixing) are produced for the shield connector body 102 in this idle state, two on the lateral limitations
35 124, 125 of the guide slot 120 and one on the base 113 or basket base 113 of the leaf spring 110.

If now the connector 1 or the shielding 10 is fitted together with the mating connector 2 or the shielding 20 respectively (see Fig. 7), the shielding 20 or the contact surface 200 of the shielding 20 exerts a force F inwards on the shield connector body 102 (see Fig. 5). In such case, the shield connector body 102 moves inwards into the shielding 20, this movement being cushioned by the bearing 110 or the leaf spring 110; the leaf spring 110 or the basket spring 110 is deflected. The guideway 130 for the shield connector body 102, which is still permanently seated at two points, is constituted on one hand on the contact surface 200 of the shielding 20 (see Fig. 9) and on the other hand on the base 113 or basket base 113 of the leaf spring 110. The lateral limitations 124, 125 of the guide slot 120 are released but intact (see Fig. 5); rolling contacting according to the invention of the shielding 10 or the shielding 20, i.e. of both shieldings 10, 20, is yielded. The shield connector body 102 can move, in particular roll, between the lateral limitations 124, 125 of the guide slot 120 and the walls 112, 116 or basket walls 112, 116 of the leaf spring 110 or the basket spring 110 respectively (see Fig. 8).

Of course, a large number of modifications of the embodiment illustrated are possible. Thus for example the leaf spring 110 may be attached to the shielding 10 not at a longitudinal end of the guide slot 120, but alternatively at a transverse end. Attachment of the leaf spring 110 via the base spring arm 111 may take place at an end facing a free end of the shielding 110. In the present case, the basket spring 110 is preferably open on its sides 114, 115; here, however, a lateral or in each case a lateral basket wall can be provided. The counter-bearing 120 may optionally additionally be formed as a spring, analogously to the bearing 110. Etc. - Further, the shielding 10 may have a spring tab 150 for centring the shieldings 10, 20 or the connector 1 relative to the mating connector 2, the spring tab 150 possibly having a contact bump 151.

List of reference numerals

- 1 electrical/electronic/electro-optical connector [mating
5 connector] (rectilinear or angled), e.g.: connection
means, interface (physical), plug means, plug-in
connector, socket connector and/or pin connector, hybrid
connector, header or connection head, integrated plug,
integrated socket, plug receptacle, socket receptacle,
10 (floating) coupling, cable fitting, male cable connector
etc. for low-voltage, medium-voltage or high-
voltage/low-current, medium-current or high-current
applications preferably for the automotive sector
- 2 electrical/electronic mating connector [connector],
15 formed complementarily to the connector 1
- 10 electromagnetic shielding of the connector 1, shield
plate/part
- 20 electromagnetic shielding of the mating connector 2,
20 shield plate/part
- 40 electromagnetic shielding of a connector 1 in accordance
with the prior art (Fig. 1)
- 100 shield contact means for electrical contacting of the
25 shieldings 10, 20
- 102 separate electrical shield connector body/shield contact
body: e.g. rolling and/or sliding body, round body with
at least two-dimensional, preferably spherical,
rounding, (partially) spherical body, partial sphere
30 (spherical body), sphere section (hemisphere
(/hemispherical body)), partial ellipsoid, ellipsoid,
barrel-type roller, cylindrical roller, tapered roller,
preferably sphere (/spherical body), ball contact
- 103 section of the shield connector body 102 protruding from
35 the counter-bearing 120 (only in the disconnected
position T)

- 110 bearing for shield connector body 102 e.g.: spring, leaf
spring, i-shaped, l-shaped or u-shaped spring arm, at
least u-shaped basket spring, disc spring, helical
spring, flexible spring, torsion spring, elastomer
5 (spring), rubber (spring), elastic component made of
elastomer, rubber, silicone etc.
- 111 base spring arm, part of the spring arm/basket spring,
attachment, preferably integrally, to shielding 10
- 112 rear wall or basket wall, part of the spring arm/basket
10 spring
- 113 base or basket base, part of the spring arm/basket
spring
- 114 preferably open basket side, optionally lateral basket
wall
- 15 115 preferably open basket side, optionally lateral basket
wall
- 116 front wall or basket wall, part of the spring arm/basket
spring (optional)
- 120 counter-bearing for shield connector body 102, guide
20 slot, optionally partial through-slot
- 122 rear limitation, optionally identical to rear wall 112
or basket wall 112
- 124 lateral limitation
- 125 lateral limitation
- 25 126 front limitation, optionally identical to front wall 116
or basket wall 116
- 127 front end of the guide slot 120
- 130 guide, guideway of the shield connector body 102 in the
shield contact means 100, constituted by bearing 110 and
30 counter-bearing 120
- 140 shield contact tab in accordance with the prior art
(Fig. 1)
- 141 shield contact bump (Fig. 1)
- 150 spring tab for centring the shieldings 10, 20 or the
35 connector 1 relative to the mating connector 2
- 151 contact bump

- 200 contact surface, preferably internally in the mating connector 2, for electrical contact with the shield connector body 102
- 5 F force on shield connector body 102 due to shielding 20
H vertical direction of connector 1 or mating connector 2
L longitudinal direction of connector 1 or mating
connector 2, optionally direction of joining, of
connection, of plugging of the connector 1 onto/into the
10 mating connector 2
Q transverse direction of connector 1 or mating connector
2
T disconnected position of connector 1 and/from mating
connector 2
15 V connection position, contact position, insertion
position of connector 1 and/with mating connector 2

Claims

1. Electromagnetic shielding for an electrical, electronic
5 or electro-optical connector (1) for use in the low-voltage,
medium-voltage or high-voltage and/or low-current, medium-
current or high-current range, in particular for motor
vehicles, with a shield contact means (100) for electrically
contacting an electromagnetic shielding (20) of a mating
10 connector (2), characterised in that

the shield contact means (100) has a separate electrical
shield connector body (102), with for a position (V) in which
the connector (1) is connected to the mating connector (2),
the shielding (10) of the connector (1) being able to be
15 connected in electrically conductive manner to the shielding
(20) of the mating connector (2) by means of the shield
connector body (102).

2. Electromagnetic shielding according to the preceding
20 claim, characterised in that the shield connector body (102)
is formed as a rolling and/or sliding body, as a round body
with at least two-dimensional rounding, as an ellipsoid or as
a spherical body (102).

25 3. Electromagnetic shielding according to one of the
preceding claims, characterised in that the shield contact
means (100) is formed such that the shield connector body
(102) for the connection position (V) can be provided between
the shielding (10) of the connector (1) and the shielding
30 (20) of the mating connector (2).

4. Electromagnetic shielding according to one of the
preceding claims, characterised in that the shield connector
body (102) is mounted on/in the shielding (10) of the
35 connector (1), and the shield connector body (102) for the
connection position (V) can be pressed against the shielding
(20) of the mating connector (2).

5. Electromagnetic shielding according to one of the preceding claims, characterised in that the shield contact means (100) has a bearing (110) and a counter-bearing (120) for the shield connector body (102) which hold the shield connector body (102) on/in the shielding (10) of the connector (1) in a position (T) in which the connector (1) is disconnected from the mating connector (2),

the bearing (110) for the shield connector body (102) being formed, in particular cut free, so as to be preferably comparatively bending-resilient and/or of elastic material, and the counter-bearing (120) for the shield connector body (102) so as to be preferably comparatively bending-resistant and/or of inelastic material, out of the shielding (10) of the connector (1).

6. Electromagnetic shielding according to one of the preceding claims, characterised in that the shield contact means (100) has a spring (110) or an elastic region or elastic component, by means of which the shield connector body (102) can be pressed against the shielding (20) of the mating connector (2), and/or

in that the shield contact means (100) has a guide slot (120) for the shield connector body (102), in the limitation of which the shield connector body (102) can be held in the disconnected position (T) and/or can be guided for the connection position (V).

7. Electromagnetic shielding according to one of the preceding claims, characterised in that the spring (110) is formed as a leaf spring (110) or as a basket spring (110),

the leaf spring (110) or the basket spring (110) and the guide slot (120) being able to be combined together such that the shield connector body (102) is held on/in the shield contact means both in the disconnected position (T) and in the connection position (V).

8. Electromagnetic shielding according to one of the preceding claims, characterised in that in the disconnected position (T) the shield connector body (102) protrudes out of the guide slot (120) with a section (103),

5 the section (103) of the shield connector body (102), upon connection of the connector (1) to the mating connector (2), being able to be contacted mechanically and electrically by the shielding (20) of the mating connector (2).

10 9. Electromagnetic shielding according to one of the preceding claims, characterised in that:

- the shield connector body (102) is a component separate from the shielding (10) of the connector (1);
- the shielding (10, 20) of the connector (1) and/or of the mating connector (2) is formed in one part, in one piece, 15 in one piece in terms of material or integrally;
- the bearing (110) or the spring (110) and/or the counter-bearing (120) of the shield connector body (102) is formed in one piece in terms of material or integrally with the shielding (10) of the connector (1); and/or 20
- the shielding (10) has a spring tab (150) for centring the shieldings (10, 20).

10. Electrical, electronic or electro-optical connector for low-voltage, medium-voltage or high-voltage and/or low-current, medium-current or high-current applications, in particular for the automotive sector, characterised in that

25 the electrical, electronic or electro-optical connector (1) has an electromagnetic shielding (10), the shielding (10) of the connector (1) being formed according to one of Claims 1 to 9.

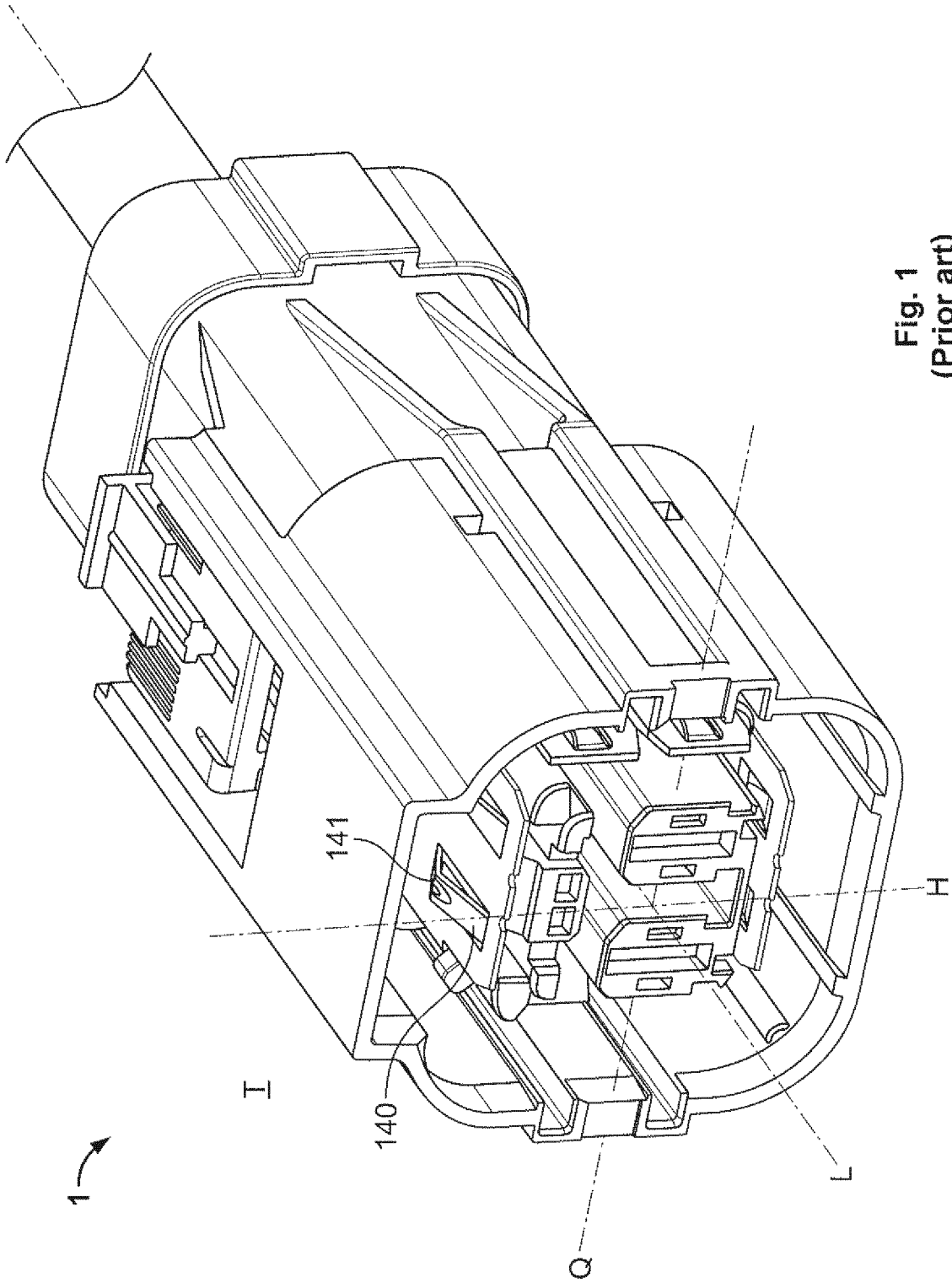


Fig. 1
(Prior art)

2/5

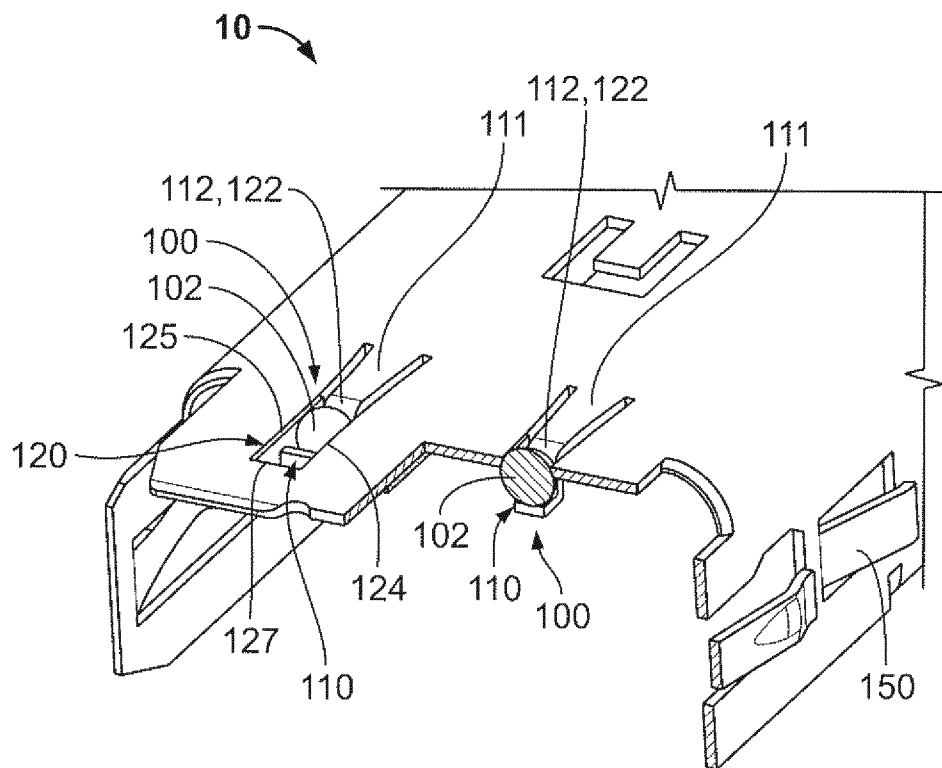


Fig. 2

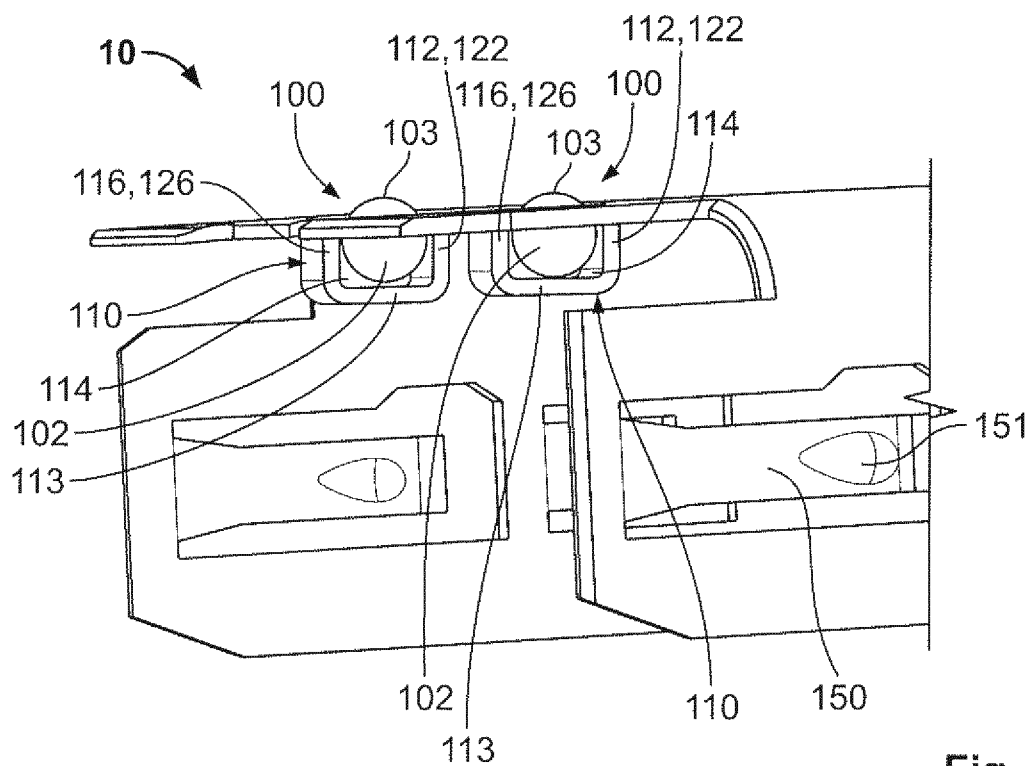


Fig. 3

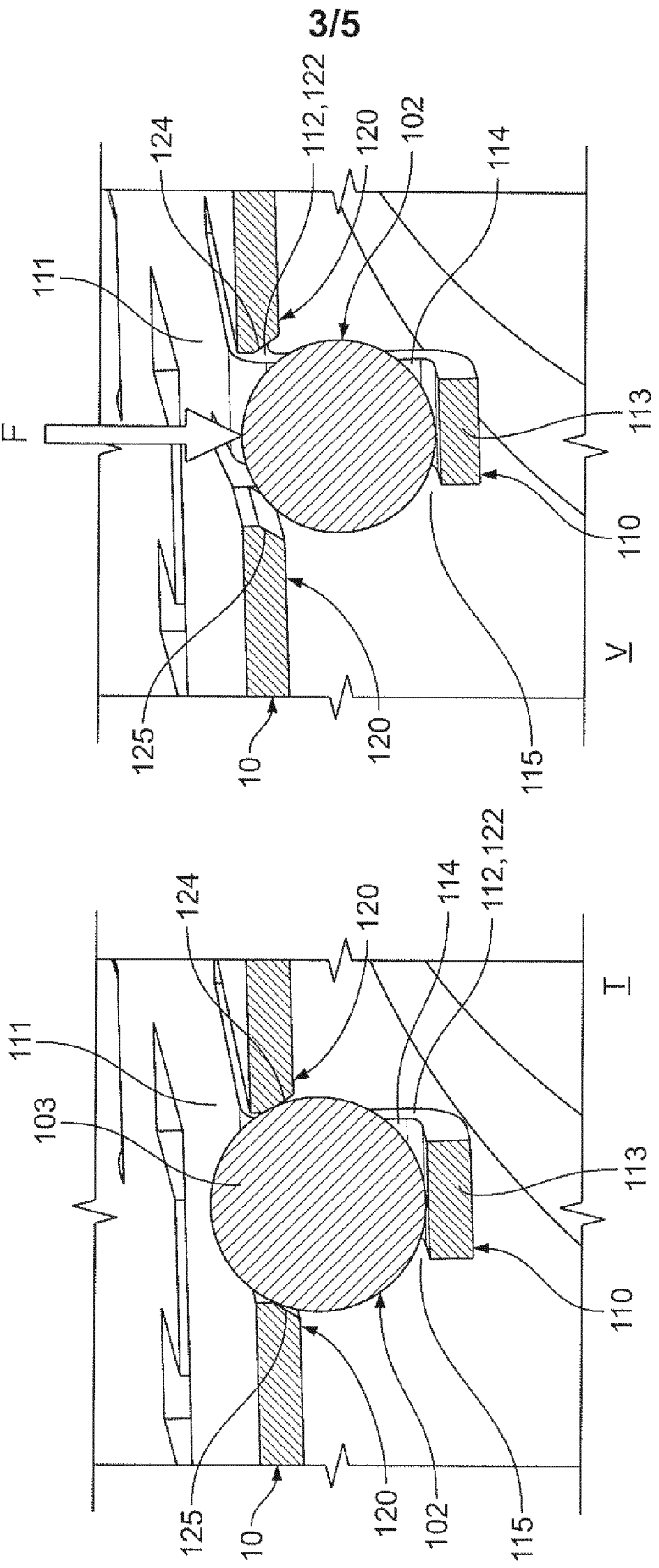
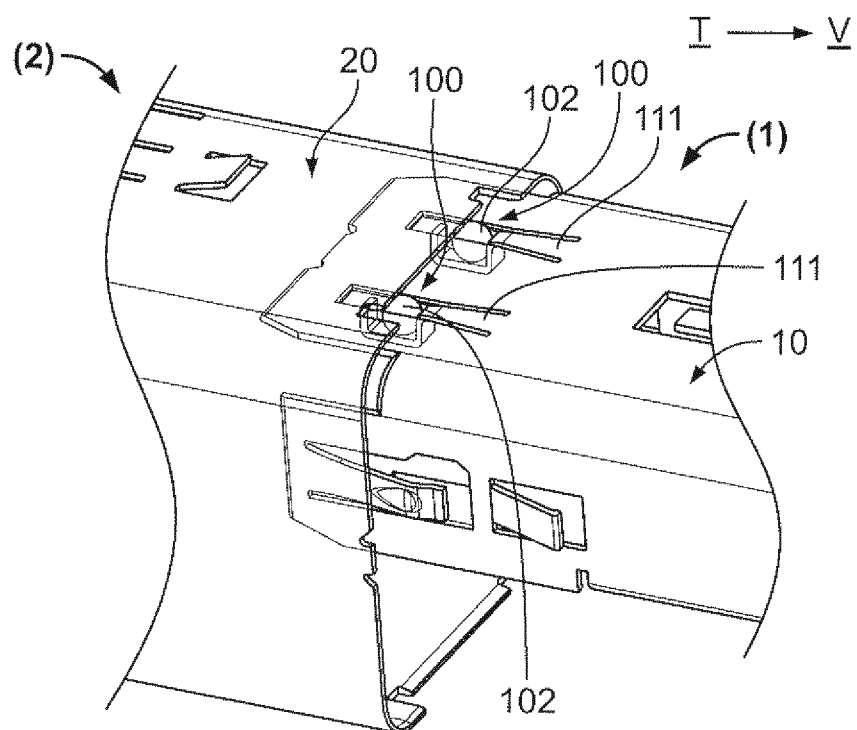
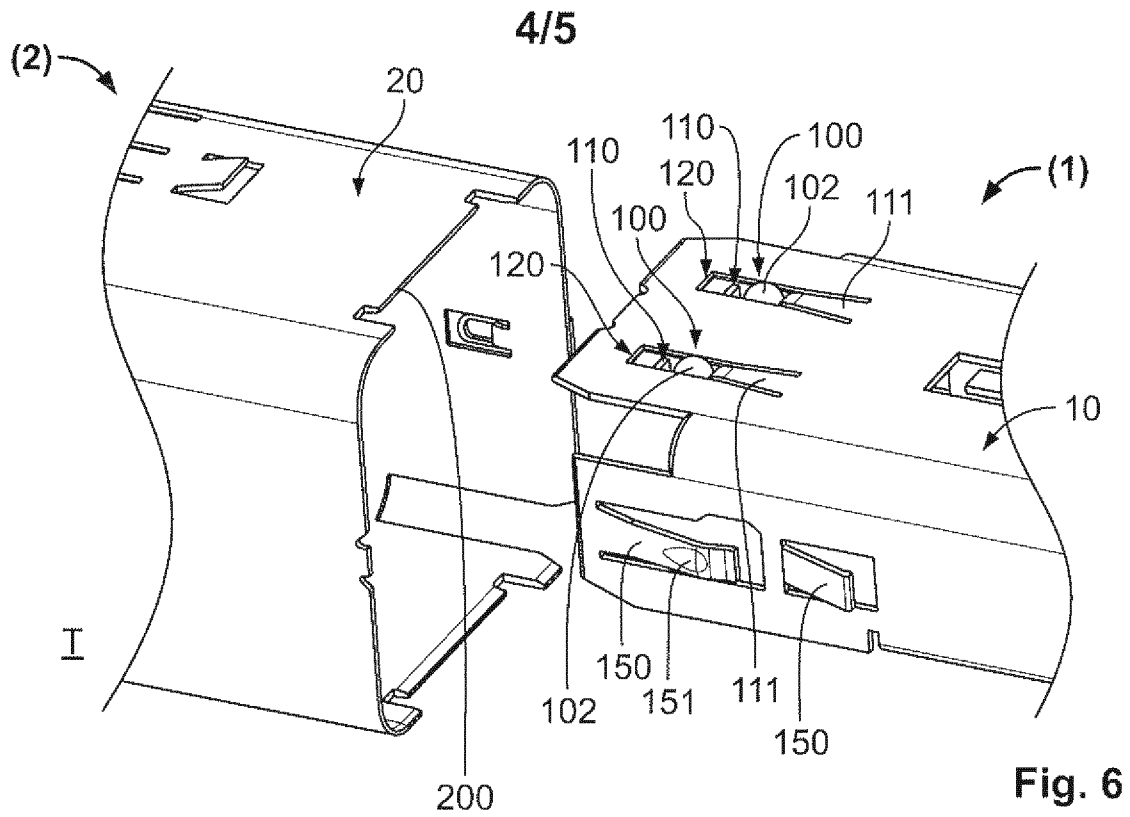


Fig. 4

Fig. 5



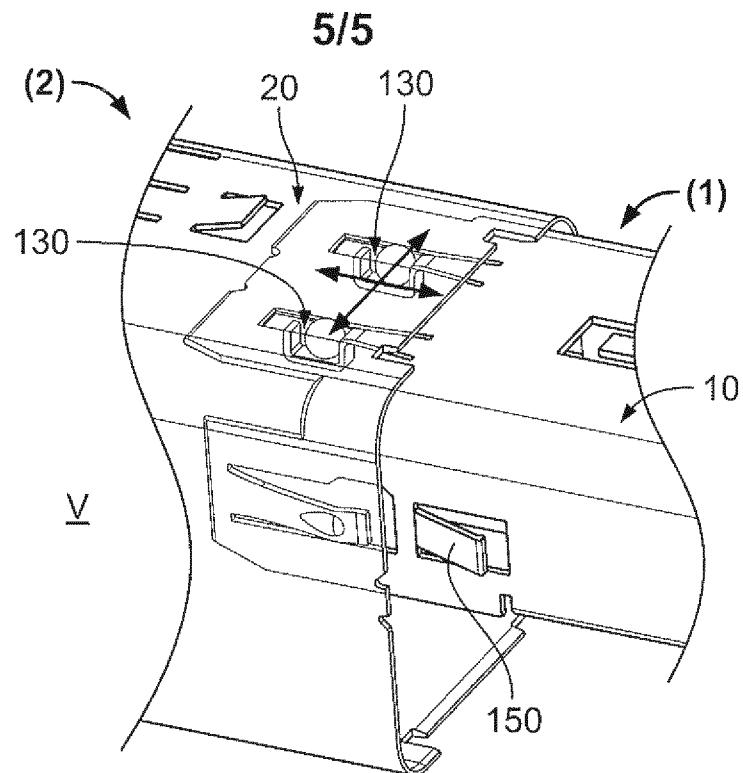


Fig. 8

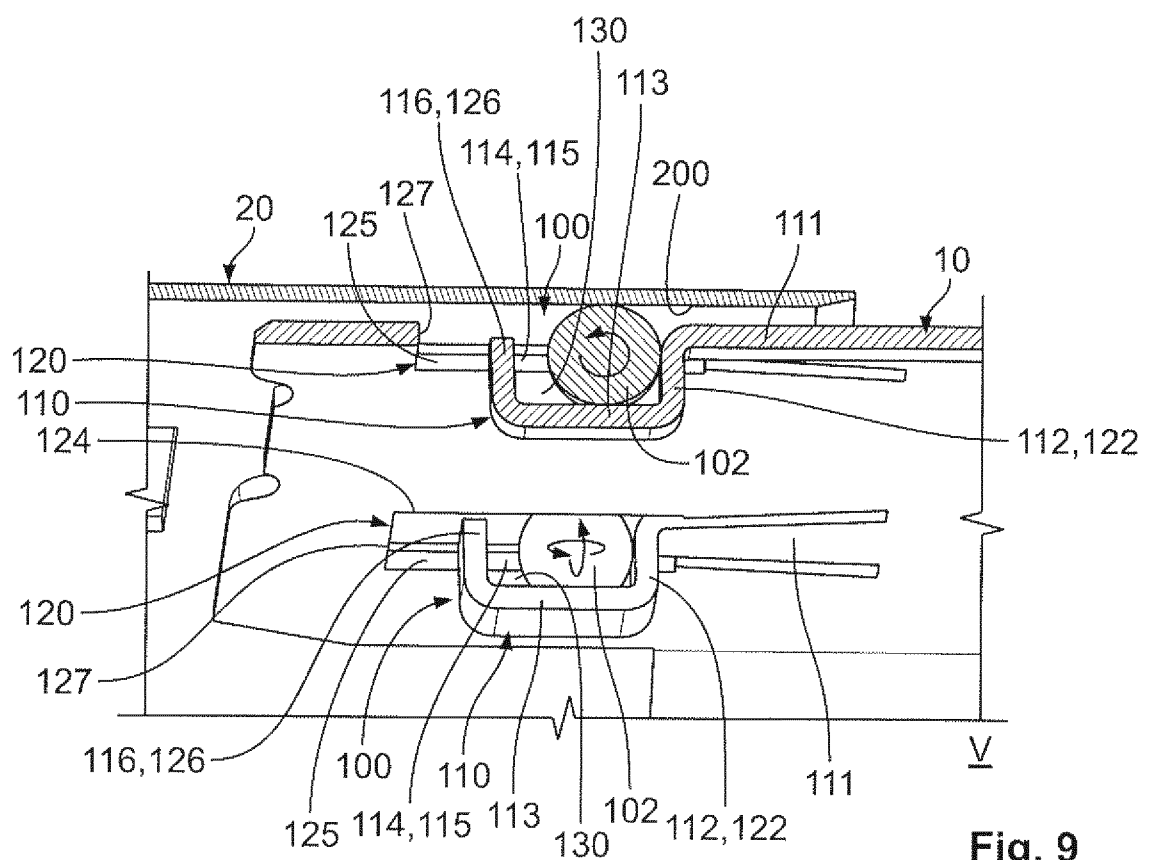


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/069872

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/50 H01R13/6583
ADD. H01R33/975

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 310 945 A2 (ITT [US]) 12 April 1989 (1989-04-12)	1,3-10
Y	paragraphs [0011] - [0012]; figures 1-12 -----	2
X	US 7 530 845 B1 (YANG HAVEN [TW]) 12 May 2009 (2009-05-12) abstract; figures 2,3 -----	1,3,4,10
Y	US 2011/237134 A1 (GAO ZHENG [US] ET AL) 29 September 2011 (2011-09-29) paragraphs [0051] - [0056], [0066]; figures 5A-7B, 12A-12F -----	2
A	EP 2 400 599 A1 (SHENZHEN NETCOM ELECT CO LTD [CN]) 28 December 2011 (2011-12-28) abstract; figure 1 ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

6 November 2013

Date of mailing of the international search report

14/11/2013

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/069872

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/220663 A1 (MA WEN-QIANG [CN]) 11 September 2008 (2008-09-11) claim 1; figures 1-4 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/069872

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0310945	A2	12-04-1989	EP 0310945 A2	12-04-1989
			US 4808126 A	28-02-1989

US 7530845	B1	12-05-2009	NONE	

US 2011237134	A1	29-09-2011	NONE	

EP 2400599	A1	28-12-2011	CN 102237583 A	09-11-2011
			EP 2400599 A1	28-12-2011
			US 2012052743 A1	01-03-2012
			WO 2011130967 A1	27-10-2011

US 2008220663	A1	11-09-2008	CN 201029132 Y	27-02-2008
			US 2008220663 A1	11-09-2008
