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(54) **Electromagnetic shielding assembly for an electrical high power connector assembly**

(57) The present invention relates to an electromagnetic shielding assembly (200) for electromagnetically shielding an electrical power transmitting arrangement (307, 500), comprising at least one shielding sleeve (210; 210') having at least one shield contact tongue (211), integrally formed with and connected to the shielding

sleeve (210;210') on one end (213), and being provided with a free end (215), whereby the free end (215) comprises at least one connection portion (217) which is mechanically and electrically coupled to the shielding sleeve (210;210').

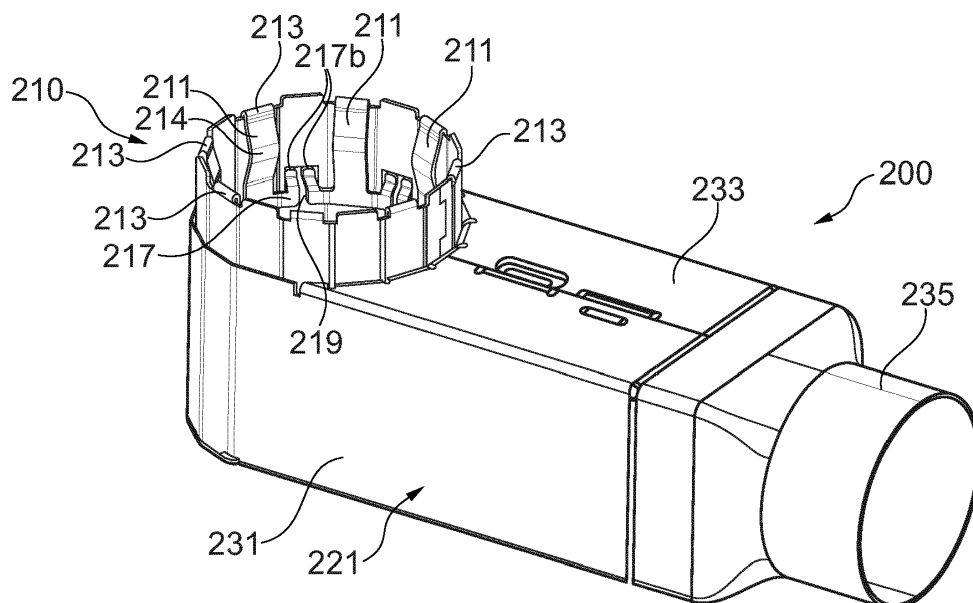


Fig. 6

Description

Technical Field of the invention

[0001] The present invention relates to an electromagnetic shielding assembly for electromagnetically shielding an electrical power transmitting arrangement comprising at least one shielding sleeve having at least one shield contact tongue integrally formed with and connected to the shielding sleeve on one end and being provided with a free end.

Background of the invention

[0002] Electrical cables and electrical connections often need to be electromagnetically shielded. In particular, in the newly growing field of hybrid or electrical vehicles, high power requirements translate into electrical circuits transporting large electrical currents and holding high voltages. As a result of the high electrical powers involved, shielding the used connectors and cables is an essential need. The shielding helps to avoid possible interferences induced by electromagnetic energy which otherwise could interfere with other electrical circuits, thereby deteriorating performance or potentially destroying components. Due to the large demand for electrical components, e.g. in the field of automotive applications, such components have to be efficiently and inexpensively manufactured; however, they still have to fulfill high quality standards.

[0003] An example of an electromagnetic shielding device for shielding of high power electrical cables is disclosed in document WO 2011/124562 A1. The shielding device disclosed therein has the form of a sleeve and is provided with a plurality of contact tongues being provided circularly around the shielding sleeve. Each contact tongue is integrally formed with the shielding sleeve and connected thereto on one end and is provided with a free end. The contact tongues serve to establish an electrical and mechanical connection for example with a further shielding component, when the shielding sleeve is inserted into said further shielding component.

[0004] A further prior art shielding device is disclosed in document DE 10 2009 053 779 B3. Therein, a contact arrangement is disclosed comprising a cylindrically formed shielding sleeve which similarly is provided with a plurality of contact tongues. Thereby, each contact tongue is formed integrally with the shielding sleeve and connected to the shielding sleeve on one end and being provided with a free end whereby the free end is oriented along the mating direction of the shielding sleeve with a further shielding component e.g. of a counter connector. Thus, the free end faces said further shielding component upon mating of the contact arrangement with said further shielding component.

[0005] A prior art electromagnetic shielding assembly is disclosed in document WO 2010/112898 A1. Therein, a shielding assembly is disclosed for electromagnetically

shielding an electrical power transmitting arrangement within a right angle electrical high power connector assembly. The electromagnetic shielding assembly disclosed therein comprises a first shield member and a corresponding second shield member having the form of a shielding sleeve. Upon assembly of the electrical high power connector assembly, a portion of the second shield member is received within an engagement aperture of the first member to establish an electrical connection throughout the electromagnetic shielding assembly. The second shield member is provided with a plurality of contact tongues which are bent outwardly to an angle of about 90° which serve to come into engagement with stopper walls for stopping insertion of the second shield member into its assembled position.

[0006] It turned out that prior art contact tongues provided on a shielding sleeve which usually are oriented in the mating direction of the shielding sleeve with e.g. a further shielding component, facing the further shielding component upon mating, are in danger of being undesirably bulged, bent or even damaged. However, at the same time it turned out that providing the contact tongues facing away from the further shielding component upon mating, deteriorates the current flow from the shielding sleeve towards the further shielding component. In this orientation, it was found that most likely due to a zigzag or folded current path which results from orienting the contact tongues facing away from the further shielding component, the shielding performance of the shielding components is non-optimal.

[0007] In view of the above, it is an object of the present invention to provide an electromagnetic shielding assembly for an electrical high power connector assembly which overcomes the above problems and which in particular provides contact tongues for connection of an electromagnetic shielding sleeve to a further electromagnetic shielding component, whereby the risk of undesirable bulging or bending upon mating of the shielding sleeve to the shielding component is reduced while at the same time a good shielding performance is achieved.

[0008] These and other objects which will become apparent upon reading the following description are solved by an electromagnetic shielding assembly according to claim 1, an electromagnetic shielding assembly according to claim 11 and by a method for the manufacture of an electromagnetic shielding assembly according to claim 13.

Summary of the invention

[0009] According to the invention an electromagnetic shielding assembly is provided for electromagnetically shielding an electrical power transmitting arrangement. Preferably, the power transmitting arrangement is a power contact terminal of an electrical high power connector assembly connected to a conductor of a high power electrical cable. Preferably, the power transmitting arrangement is adapted to transmit an electrical power of at least

10kW, more preferably of at least 50kW, even more preferably of at least 100kW, and most preferably of at least 150kW. Thus, e.g. due to suitable dimensions of the electrically conductive components, the power transmitting arrangement is for example adapted to transmit a current of 100Ampere at a voltage of 100Watts and thus a high electrical power of 10kW. In a preferred embodiment, the electromagnetic shielding assembly comprises the power transmitting arrangement.

[0010] According to the invention, the electromagnetic shielding assembly comprises at least one shielding sleeve having at least one shield contact tongue, integrally formed with and connected to the shielding sleeve at one end and being provided with a free end. In other words, the shield contact tongue can e.g. be formed within a surface of the shielding sleeve, preferably via stamping and bending, such that the shield contact tongue extends from the shielding sleeve from the one end and has a free end, which can e.g. be bent out of said surface, either inwardly into the interior of the shielding sleeve or outwardly towards the exterior.

[0011] The shield contact tongue is provided to establish an electrical and mechanical connection between the shielding sleeve and further components of the electromagnetic shielding assembly as for example first and second shield housing parts which in assembled condition with the shielding sleeve are adapted to house for example a right angle high power electrical contact terminal. The shield contact tongue is integrally formed with and connected to the shielding sleeve, in a preferred embodiment via stamping and bending. In other words, for the manufacture of the electromagnetic shielding assembly, according to the invention first, a sheet metal blank for forming a shielding sleeve is provided. Then, the contact tongue is formed within the sheet metal blank and the shield contact tongue preferably is stamped into the sheet metal blank for example by stamping a corresponding cut into the sheet metal blank, thus forming a tongue within said sheet metal blank. This tongue is then bent into the desired shape such that it is provided with a free end, the one end still integrally connected with the shielding sleeve. According to the invention, the free end of the shield contact tongue comprises at least one connection portion, the connection portion being mechanically and electrically coupled to the shielding sleeve. For example, in a preferred embodiment, the shield contact tongue is bent around the one end at which it is integrally connected to the shielding sleeve by essentially 180° back into the shielding sleeve until the free end of the shielding sleeve contacts for example the interior of the shielding sleeve. Preferably, the connection portion of the shield contact tongue comprises at least one wing provided within the connection portion which interacts with a corresponding recess within the shielding sleeve.

[0012] By means of the backwards bending of the shield contact tongue into the interior of the shielding sleeve, the shield contact tongue forms essentially a contact bridge within the interior of the shielding sleeve, one

end being integrally connected to the shielding sleeve and one end connected to the shielding sleeve by means of said connection portion. Thus, as opposed to conventional contact tongues, due to the inventive connection of the shield contact tongue to the shielding sleeve, undesired bulging or bending e.g. upon assembly of the shielding sleeve with further connection members is avoided. Further, due to the electrical connection of the shield contact tongue to the shielding sleeve at two connection points, i.e. at the one end at which the shield contact tongue is integrally formed with the shielding sleeve as well as at the free end, a contact bridge is formed such that current can flow directly in either connection thereby avoiding zigzagging current paths.

Description of the preferred embodiments

[0013] In the following, the invention is described exemplarily with reference to the enclosed figures, in which:

Fig. 1 shows an electrical high power connector assembly including an electromagnetic shielding assembly;

Figs. 2 and 3 illustrate the components of an electromagnetic shielding assembly;

Figs. 4 and 5 show a sheet metal blank for manufacturing a shielding sleeve and the corresponding shielding sleeve;

Fig. 6 shows the electromagnetic shielding assembly in assembled condition;

Fig. 7 shows a further sheet metal blank for the manufacture of a further embodiment of a shielding sleeve and the corresponding shielding sleeve.

[0014] Fig. 1 shows an exploded view of an electrical high power connector assembly 100. Further, a cable 300 is shown which is a typical high power electrical cable provided with a cable insulation 301, a cable shielding braid 303, and an inner insulation 305 separating the cable shielding braid from an inner conductor 307. The figure contains an exploded view of the electromagnetic shielding assembly with shielding sleeve 210, first and second shield housing parts 231, 233, and cable shielding connector 235. As it will be appreciated by the person skilled in the art, the shield housing parts 231, 233 can be assembled with the shielding sleeve 210 forming a right angle shielding assembly which can be inserted into a corresponding opening of the cable shielding connector 235. This cable shielding connector 235 is adapted to be electrically connected to the cable shielding braid 303 via shield connector rings 309. Preferably, the electrical high power connector assembly 100 further comprises a contact terminal 500 adapted to be electrically and mechanically connected to a conductor 307 of an electrical

cable, i.e. a power transmitting arrangement. In assembled condition, the shielding assembly houses first and second insulating housing halves 401, 403 which are provided to insulate the contact terminal 500 from the electromagnetic shielding device. As shown, contact terminal 500 is provided with contact springs 503 which serve to receive for example a contact pin (not shown) from a counter connector and with crimping wings 501 which serve for crimping the contact terminal 500 to the cable conductor 307.

[0015] In Fig. 1 further sealing components such as O-rings 701, a sealing housing 703 with sealing housing O-ring are shown, which are provided to seal the electrical high power connector assembly 100 against humidity or dirt.

[0016] Fig. 2 shows the cable shielding connector 235 already mounted in place on the electrical cable 300, i.e. being in contact with the cable shielding braid (not visible in Fig. 2). As one can derive from this figure, the first and second shield housing parts 231, 233 can be assembled to form a shield housing which can receive the shielding sleeve 210 through a corresponding opening. When the shielding sleeve is inserted into said shield housing, contact faces 218 are in electrical and mechanical contact with contact flanges 216 of said housing. The shielding sleeve 210 itself is adapted to receive a further shielding member 205 in its interior.

[0017] Fig. 3 shows the components of the electromagnetic shielding assembly 200 with first and second shield housing parts 231 and 233 being assembled to form a shield housing 221 and being inserted into the cable shielding connector 235 to be electrically connected to the cable shielding braid (not visible). The shielding sleeve 210 is inserted into the shield housing and the further shielding member 205 is inserted into the shielding sleeve 210.

[0018] Fig. 4 shows a sheet metal blank 201 and the corresponding shielding sleeve 210. In the shown case, the components of the shielding sleeve 210 to be manufactured are already stamped into the sheet metal blank 201. At least one further bending step may be required to achieve the final shape of each component. As shown, a central portion 214 of each shield contact tongue 211 extends from a main portion 203, thus being formed integrally with said main portion 203 at one end 213. At the opposing end, i.e. at the free end 215, two connection portions 217 are formed, each connection portion 217 being provided with a base portion 217a and a wing 217b. Thus, in a preferred embodiment, the shield contact tongue 211 comprises two wings 217b which are formed within the shield contact tongue 211, preferably via stamping and bending the shield contact tongue 211 and the wings 217b out of the shielding sleeve 210, such that the shield contact tongue and the two wings form a general T-shape.

[0019] Thus, as it will be appreciated by the person skilled in the art, to manufacture the shielding sleeve 210 from the shown sheet metal blank 201 each shield con-

tact tongue 211 is bent around the one end 213 and the wings 217b are bent thus forming a curved, essentially u-shaped form, such that the wing 217b can be inserted into corresponding locking recesses 219 provided within the main portion 203 of the sheet metal blank 201. After bending the shield contact tongues and electrically and mechanically connecting the free ends 215 of each shield contact tongue 211 to the main portion 203, i.e. the interior of the shielding sleeve 210 when manufactured, the sheet metal blank 201 is rolled thus forming the final shape of the shielding sleeve 210.

[0020] As can be derived in particular from Fig. 4, in a preferred embodiment, the shielding sleeve 210 is provided with a plurality of, preferably 4, more preferably 6, and most preferably 8, shield contact tongues 211, and a corresponding number of locking recesses 219, each shield contact tongue 211 being provided with a pair of wings 217b and each shield contact tongue 211 being bent, preferably inwardly into the shielding sleeve 210. Thus, a wing 217b of each shield contact tongue 211 is at least partially inserted into the same locking recess 219 as is a wing 217b of an adjacent shield contact tongue 211. Preferably, thereby the wings 217b extend through said locking recess 219 from the inside of the shielding sleeve 210 as illustrated in Fig. 4 towards the outside of the shielding sleeve. Thereby, the inserted wings 217b form a plurality of contact faces 218 outside of the shielding sleeve 210. As can be derived from Fig. 4 in connection with Fig. 2 above, said contact faces 218 in assembled condition of the electromagnetic shielding assembly are in electrical and mechanical contact with the contact flanges 216 of the shield housing. As can be derived from Fig. 4, due to the curved, essentially u-shaped bending of the wings 217b, these bent portions of wings 217b form essentially u-shaped contact faces 218 which are advantageous in that they facilitate insertion of shielding sleeve 210 into the shield housing without the danger of said contact faces being bulged or bent in an undesirable way. Further, due to the insertion of two wings 217b into each locking recess 219, advantageously essentially the whole open area of the locking recess 219 is filled thus reducing the loss in shielding capacity resulting from the opening due to recess 219.

[0021] As shown more in more detail in Fig. 5, in a preferred embodiment, the connection portion 217 comprises at least one base portion 217a extending from a central portion 214 of the shield contact tongue 211 in a direction essentially perpendicular to a main orientation axis 614 of the shield contact tongue 211 and the at least one wing 217b extends in a direction essentially parallel to said orientation axis 614. As it will be clear for the person skilled in the art, "*essentially perpendicular*" as well "*essentially parallel*" are not to be understood in a strict mathematical sense, however, tolerances as they can result from the manufacturing process, i.e. deviations on the order of 10% are encompassed by these terms.

[0022] Further, preferably, the shielding sleeve 210 is provided with a polygonal cross-section. As it will be clear

also in connection with Fig. 4 above, due to the bending of an initially flat sheet metal piece, the polygonal cross-section has a number of n bending edges whereby n is an integer larger than 4 and smaller 32, preferably larger than 8 and smaller than 28, more preferably larger than 12 and smaller than 22, even more preferably larger than 14 and smaller than 18 and most preferably equal to 16. Thus, preferably, sections of the polygonal cross-section provided in between adjacent bending edges 223 correspond to essentially flat first 225a and second 225b wall portions of the shielding sleeve 210. Thereby, the first 225a and second 225b wall portions are alternately provided with locking recesses 219 for the reception of wings 217b of shield contact tongues 211. For example, if the number of bending edges is equal to 16 as shown in Fig. 5, the shielding sleeve 210 is provided with alternating wall portions 225a, 225b whereby wall portions 225b are provided with locking recesses 219 each for the reception of corresponding essentially u-shaped bent wings 217b of shield contact tongues 211. Thus, preferably, the shield contact tongue 211 is bent inwardly into the shielding sleeve 210 as shown in Fig. 5 and the wings 217b are at least partially inserted into the locking recess 219 from inside of the shielding sleeve, a curved portion of the wings 217b extending through the locking recess 219 from the inside of the shielding sleeve 210 towards the outside of the shielding sleeve 210 thus forming contact faces 218.

[0023] Fig. 6 shows the electromagnetic shielding assembly 200 in assembled condition, i.e. with first and second shield housing parts 231, 233 assembled to form a shield housing 221 being inserted into the cable shielding connector 235. The shielding sleeve 210 is inserted into a corresponding opening of said shield housing. In this assembled condition, the shield contact tongues 211 are bent inwardly into the shielding sleeve 210 around the one end 213 at which they are integrally formed with the shielding sleeve 210. Thus, wings 217b provided within each connection portion 217 of the contact tongues 211 are inserted in pairs into corresponding locking recesses 219, each pair of wings from adjacent shield contact tongues 211. As shown, each main portion 214 is bent inwardly towards the inside of shielding sleeve 210, thus forming a plurality of contact points to establish an electrical connection for example with the further shielding member 205 (see Figs. 2 and 3 above).

[0024] Fig. 9 shows a shield metal blank 201' for forming a further embodiment of the shielding sleeve 210'. As one can derive from this figure, the shielding sleeve 210' essentially corresponds to the shielding sleeve shown for example in Fig. 4 above (like reference numerals indicate corresponding components). However, in this preferred embodiment, the shielding sleeve 210' is further provided with a plurality of outwardly oriented contact legs 227, which are integrally formed with the shielding sleeve 210' by stamping and bending on outer walls 225a' of the shielding sleeve 210', which preferably is not provided with a locking recess 219'. Thus, the contact

legs 227 are provided to complete the outer contact faces being provided around the shielding sleeve 210' to improve the possibility of a continuous outer electrical contact for example to the above described contact flanges 216 of the shield housing.

[0025] It was found by the present inventors that by the above described construction and in particular by the provision of the contact tongue 211 being integrally connected at the one end 213 and mechanically connected at the free end 215 to the shielding sleeve 210; 210' the above discussed problems can be overcome. Due to the inventive shape of the contact tongue 211, firstly the danger of bulging or undesired bending or even breaking of the contact tongue upon inserting for example of the further shielding member into the shielding sleeve 210; 210' can be avoided. Further, due to the avoidance of zig-zagging currents, the overall shielding performance of the inventive electromagnetic shielding assembly can be drastically improved. For example, it was found experimentally that with the inventive shielding assembly, a shielding of 80 dB could be achieved at a frequency of 100 MHz, while with comparable prior art designs lower values of only up to 63dB are achievable.

Claims

1. Electromagnetic shielding assembly (200) for electromagnetically shielding an electrical power transmitting arrangement (307, 500), comprising at least one shielding sleeve (210; 210') having at least one shield contact tongue (211), integrally formed with and connected to the shielding sleeve (210; 210') on one end (213), and being provided with a free end (215),
characterized in that
the free end (215) of the shield contact tongue (211) comprises at least one connection portion (217), the connection portion (217) being mechanically and electrically coupled to the shielding sleeve (210; 210').
2. Electromagnetic shielding assembly (200) according to claim 1, **characterized in that** the connection portion (217) of the shield contact tongue (211) comprises at least one wing (217b) and the shielding sleeve (210; 210') comprises at least one locking recess (219), such that in assembled condition of the electromagnetic shielding assembly (200), the at least one wing (217b) is at least partially inserted into the locking recess (219) for mechanically and electrically coupling the shield contact tongue (211) to the shielding sleeve (210; 210').
3. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shield contact tongue (211) comprises two wings (217b) which are formed with the shield

contact tongue (211), preferably via stamping and bending the shield contact tongue (211) and the wings (217b) out of the shielding sleeve (210; 210'), such that the shield contact tongue (211) and the two wings (217b) form a general T-shape.

4. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shield contact tongue (211) further comprises at least one base portion (217a) extending from a central portion (214) of the shield contact tongue (211) in a direction essentially perpendicular to a main orientation axis (614) of the shield contact tongue (211), and the at least one wing (217b) extends in a direction essentially parallel to said orientation axis (614).

5. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shielding sleeve (210; 210') comprises at least two shield contact tongues (211) and a number of locking recesses (219) corresponding to the number of shield contact tongues (211), and **in that** a wing (217b) of each shield contact tongue (211) is at least partially inserted into the same locking recess (219) as is a wing (217b) of an adjacent contact tongue (211).

6. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shielding sleeve (210; 210') is provided with a polygonal cross-section, the polygonal cross-section having a number of n bending edges (223), with n being an integer larger than 4 and smaller than 32, preferably larger than 8 and smaller than 28, more preferably larger than 12 and smaller than 22, even more preferably larger than 14 and smaller than 18 and most preferably equal to 16.

7. Electromagnetic shielding assembly (200) according to claim 6, **characterized in that** sections of the polygonal cross-section provided in between adjacent bending edges (223) correspond to essentially flat first and second wall portions of the shielding sleeve (210; 210'), whereby the first and second wall portions are alternately provided with locking recesses (219) for the reception of wings (217b) of shield contact tongues (211).

8. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shielding sleeve (210') is further provided with a plurality of outwardly oriented contact legs (227), which are integrally formed with the shielding sleeve (210') by stamping and bending, on outer walls (225a') of the shielding sleeve (210'), which are not provided with a locking recess (219').

9. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shield contact tongue (211) is bent inwardly into the shielding sleeve (210; 210') and **in that** the wings (217b) are inserted at least partially into the locking recess (219) from inside the shielding sleeve, a curved portion of the wings (217b) extending through the locking recess (219) towards the outside of the shielding sleeve (210; 210').

10. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shielding sleeve (210; 210') is provided with a plurality of, preferably 4, more preferably 6, and most preferably 8, shield contact tongues (211), and a corresponding number of locking recesses (219), each shield contact tongue (211) being provided with a pair of wings (217b) and each shield contact tongue (211) being bent, preferably inwardly into the shielding sleeve (210; 210'), such that a wing (217b) of each shield contact tongue (211) is at least partially inserted into the same locking recess (219) as is a wing (217b) of an adjacent shield contact tongue (211), preferably wherein the wings (217b) extend through said locking recess (219) from the inside of the shielding sleeve (210; 210') towards the outside of the shielding sleeve (210; 210'), thus forming a plurality of contact faces (218) arranged around the shielding sleeve (210; 210').

11. Electromagnetic shielding assembly (200) according to any one of the preceding claims, **characterized in that** the shield contact tongue (211) is formed integrally with the shielding sleeve (210; 210') by stamping and bending.

12. Electrical high power connector assembly (100) comprising the electromagnetic shielding assembly (200) according to any one of the preceding claims 1 to 11, preferably wherein the electrical high power connector assembly (100) further comprises a contact terminal (500) adapted to be electrically and mechanically connected to a conductor (307) of an electrical cable (300), the contact terminal (500) and the conductor (307) forming a power transmitting arrangement (307, 500) when the conductor (307) is connected to the contact terminal (500), whereby the electromagnetic shielding assembly (200) is adapted to house, preferably houses, the power transmitting arrangement (307, 500).

13. Method for the manufacture of an electromagnetic shielding assembly (200) according to any one of the preceding claims 1 to 11, comprising the following steps:

- providing a sheet metal blank (201; 201') for forming a shielding sleeve (210; 210');

- forming at least one shield contact tongue (211) and at least one locking recess (219) within the sheet metal blank (201; 201'), such that the shield contact tongue (211) is integrally formed on one end (213), and is provided with a free end (215) and a connection portion (217) with at least one wing (217b); 5
- bending the shield contact tongue (211), preferably by an angle of more than 90°, preferably more than 120°, around the edge (213), preferably inwardly into the shielding sleeve (210; 210'); 10

characterized in that

the method further comprises 15

- mechanically and electrically coupling the connection portion (217) to the locking recess (219) by at least partially inserting the wing (217b) into the locking recess (219). 20

14. Method according to claim 13, further comprising bending the wing (217b) into a curved, preferably partially u-shaped form, and inserting the wing (217b) into the locking recess (219) such that at least a portion of the wing (217b) extends through the locking recess (219) preferably towards the outside of the shielding sleeve (210; 210') thus forming a contact face (218) preferably outside of the shielding sleeve (210; 210'). 25 30
15. Method according to claim 13 or 14, further comprising providing at least one further shield contact tongue (211) with at least one wing (217b) and inserting the wing (217b) of the further shield contact tongue (211) and the wing (217b) of the shield contact tongue (211) into the same locking recess (219). 35

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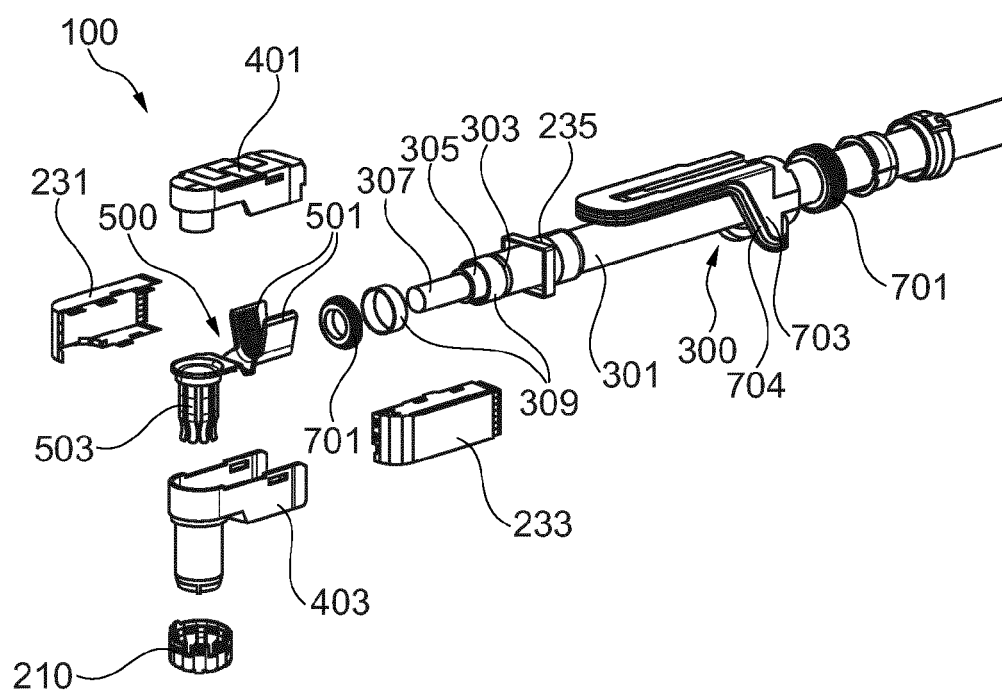


Fig. 1

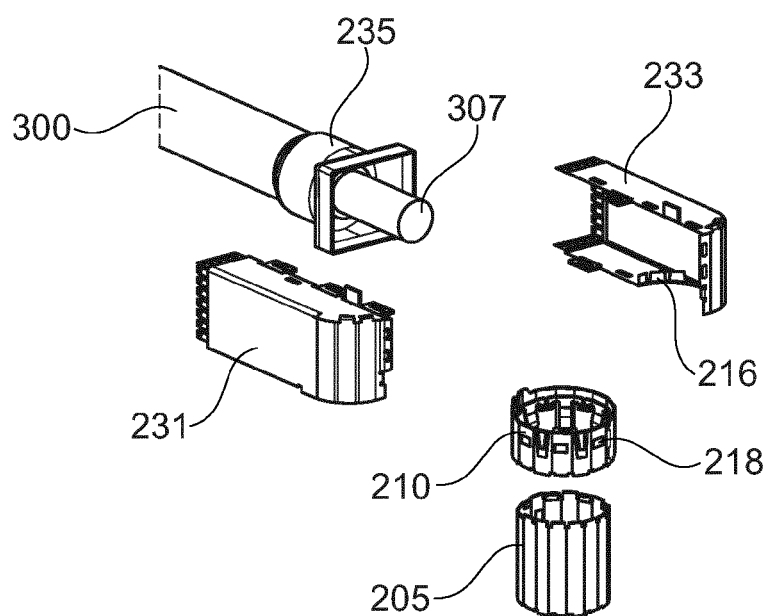


Fig. 2

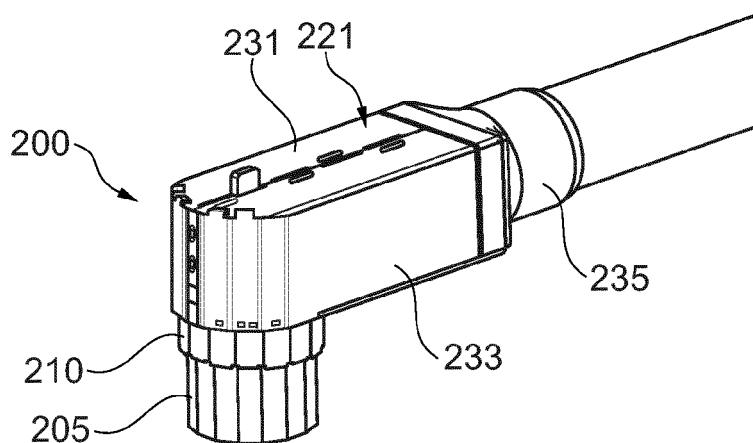


Fig. 3

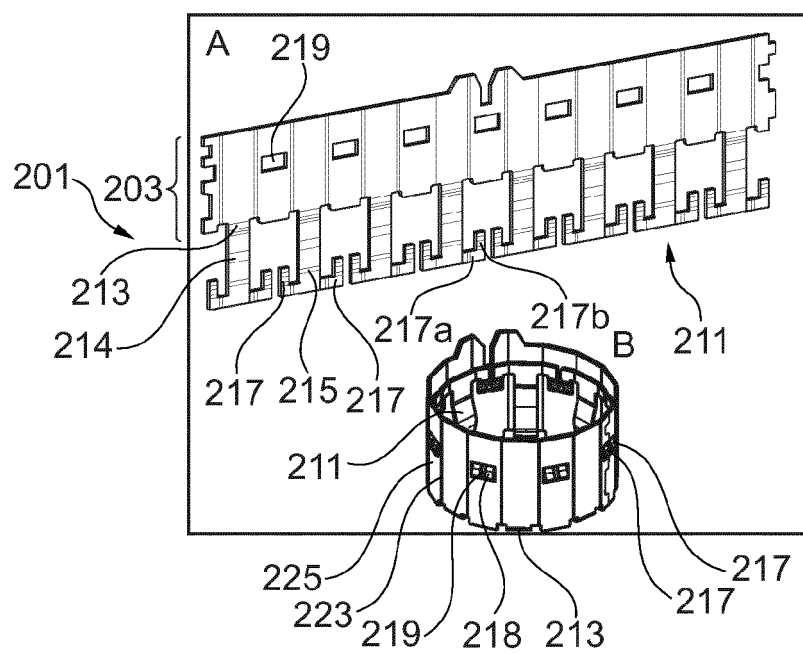


Fig. 4

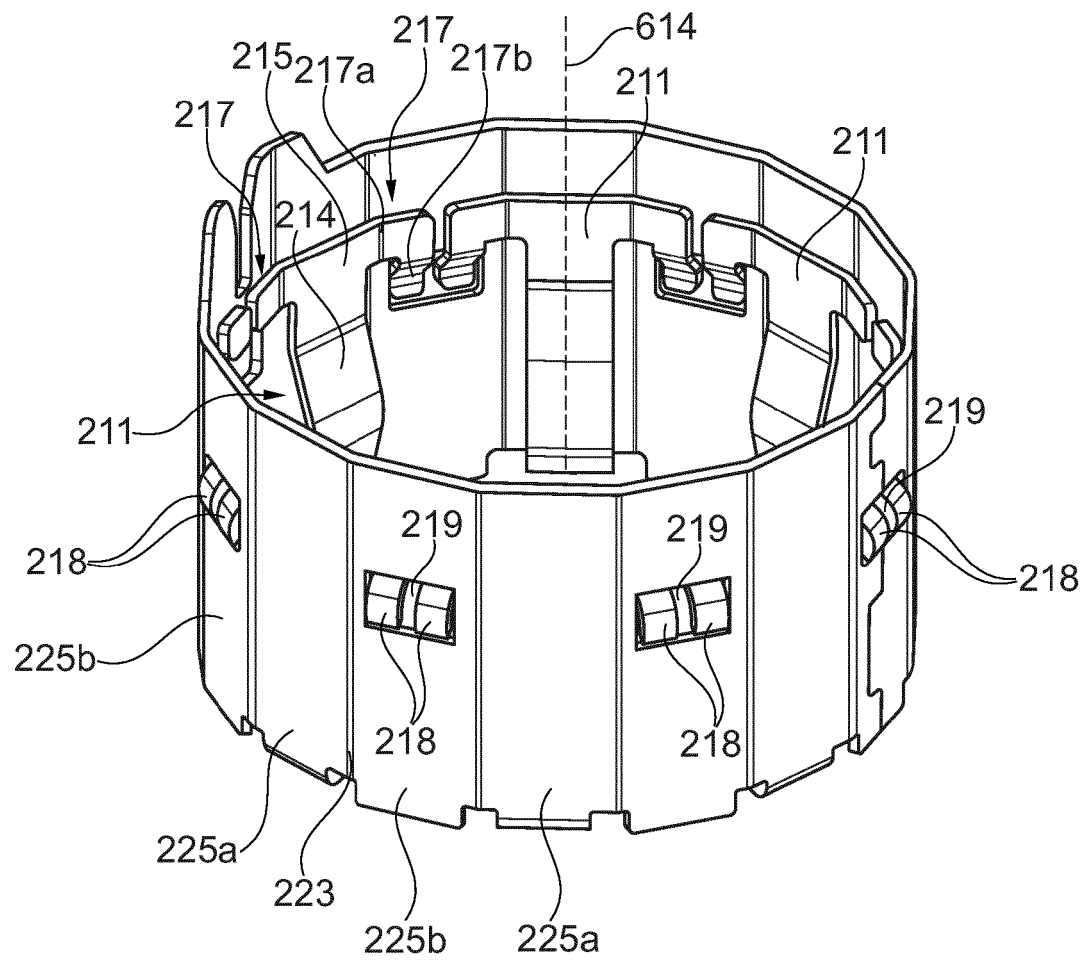


Fig. 5

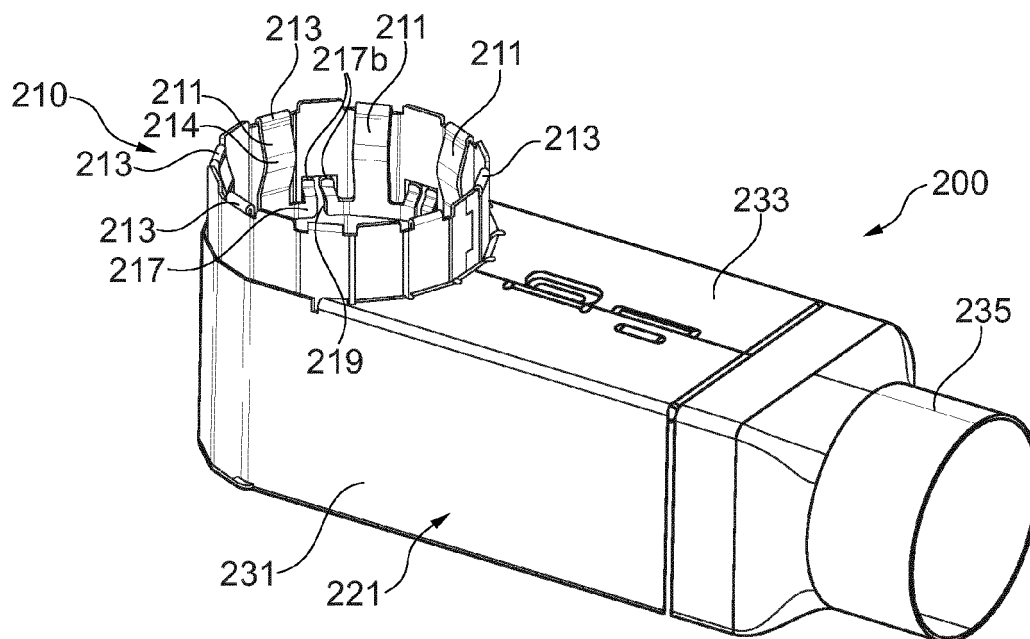


Fig. 6

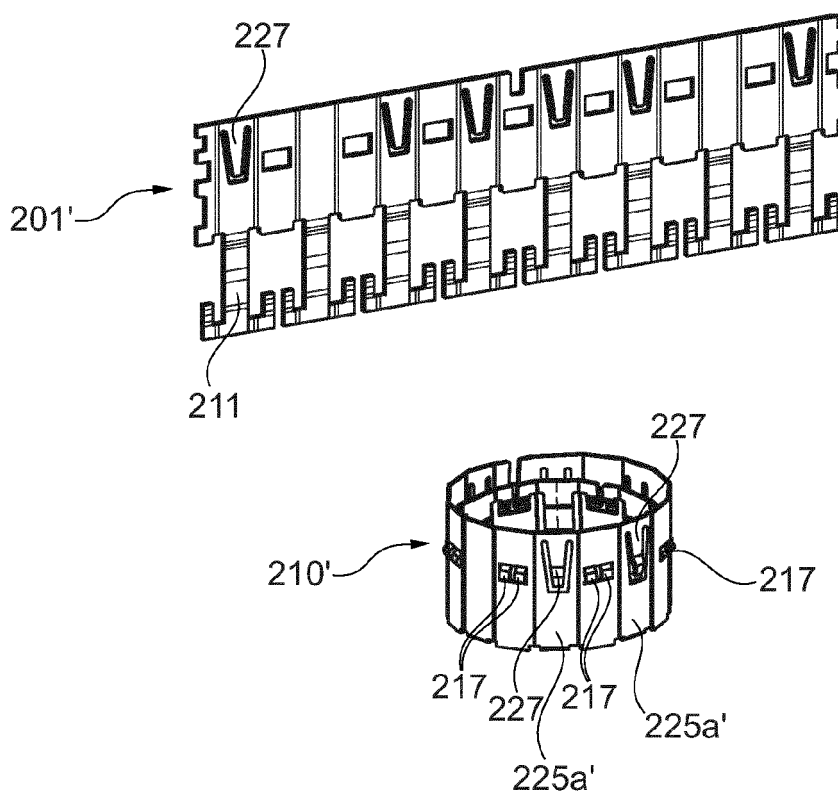


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 13 18 1660

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 January 2014	Examiner Bouhana, Emmanuel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 18 1660

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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