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(54) **HOLLOW CONDUCTOR CONNECTING MEMBER, HOLLOW CONDUCTOR SYSTEM AND METHOD FOR FORMING A HOLLOW CONDUCTOR SYSTEM**

(57) A hollow conductor connecting member (16) for connecting two hollow conductors (12, 14; 50, 52, 54) is described wherein the connecting member (16) comprises at least one main body (18) extending in an axial direction (A). The main body (18) is configured such that it can be inserted into the hollow conductors (12, 14; 50,

52, 54) at least partly. The area of the cross section of the main body (18) varies along the axial direction (A) of the connecting member (16). Further, a hollow conductor system (10) and a method for forming a hollow conductor system (10) are described.

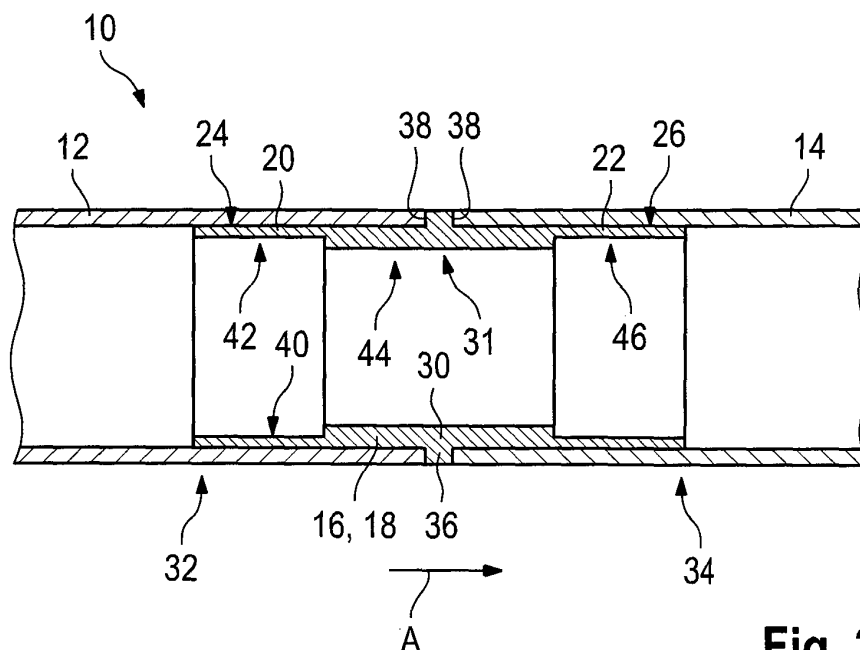


Fig. 2

Description

[0001] The invention relates to a hollow conductor connecting member, a hollow conductor system as well as a method for forming a hollow conductor system.

[0002] In general, a hollow conductor connecting member is used to connect two separately formed hollow conductors. Depending on its shape, the hollow conductor connecting member may have different characteristics. For instance, the hollow conductor connecting member can be an E-plane bend or an H-plane bend.

[0003] Usually, a hollow conductor connecting member is formed as a muffle wherein the hollow conductor connecting member has connecting portions which surround the hollow conductors wherein the hollow conductors may be formed rectangular. The hollow conductors and the hollow conductor connecting member placed between the hollow conductors establish a hollow conductor system which ensures that the electromagnetic waves propagating through the hollow conductors and the hollow conductor connecting member are transferred to a desired location.

[0004] Generally, hollow conductors are also called wave guides, hollow wave guides, rectangular wave guides, HF-wave guides, hollow-metallic wave guides, etc.

[0005] Such a hollow conductor system may be used in satellite applications which typically have restricted available space for the hollow conductor system. The hollow conductor system is connected to a payload of the satellite, for instance measurement and/or analyzing devices, as well as an antenna system such that the signals can be transmit between the payload and the antenna system. In satellite applications, the most demanding requirements are the insertion loss of the hollow conductor system as well as its mass since satellite applications generally demand for lightweight systems.

[0006] In addition, satellite applications may use a multi-beam system which means that a plurality of hollow conductor systems are required which in turn increases the total weight of the dedicated satellite application. Thus, the launch of the satellite is more expensive due to the increased total weight of the satellite application.

[0007] In the prior art, the thickness of the walls of the hollow conductors have been reduced to a minimum such that the total weight of each hollow conductor system is reduced. However, the thickness can only be reduced to a certain thickness for reasons of mechanical stability.

[0008] Accordingly, a lightweight, cost-optimized and mechanically stable hollow conductor system is required.

[0009] The invention provides a hollow conductor connecting member for connecting two hollow conductors wherein the connecting member comprises at least one main body extending in an axial direction wherein the main body is configured such that it can be inserted in the hollow conductors at least partly wherein the area of the cross section of the main body varies along the axial direction of the connecting member.

[0010] Further, the invention provides a hollow conductor system comprising at least two hollow conductors and at least one hollow conductor connecting member, in particular at least one hollow conductor connecting member as described above, wherein the hollow conductors are connected to each other via the hollow conductor connecting member wherein the hollow conductor connecting member has a main body and wherein the area of the cross section of the main body varies along the axial direction of the connecting member.

[0011] Moreover, the invention provides a method for forming a hollow conductor system, in particular a hollow conductor system as described above, wherein at least two hollow conductors and at least one hollow conductor connecting member, in particular a hollow conductor connecting member as described above, are provided wherein the hollow conductor connecting member has a main body and wherein the area of the cross section of the main body varies along the axial direction of the connecting member and wherein the hollow conductors are connected with each other via the at least one hollow conductor connecting member.

[0012] The invention is based on the finding that the weight can be reduced by dimensioning the hollow conductor connecting member such that it can be inserted into the hollow conductors. The area of the cross section of a portion of the hollow conductor connecting member overlapping with the hollow conductor is smaller than the one of the hollow conductor. Thus, the hollow conductor connecting member can be inserted at least partly. Moreover, the area of the cross section of the hollow conductor connecting member according to the invention is smaller than the one of a hollow conductor connecting member known in the state of the art which surrounds the hollow conductors. As the main body is configured such that it can be inserted at least partly, the outer surface of the main body may contact the inner surfaces of the hollow conductors. Thus, the hollow conductor connecting member is configured such that its outer surface contacts the inner surfaces of the hollow conductors at least partly.

[0013] In addition, the inner surface of the hollow conductor connecting member is structured since the area of the cross section of the main body varies along the axial direction being the propagation direction of the electromagnetic waves. The axial direction of the main body is perpendicular to the cross section mentioned above. The area of the cross section of the main body corresponds to an inner diameter in case of a main body having a circular cross section. Accordingly, the inner diameter would vary along the axial direction of the cylindrically formed hollow conductor connecting member, in particular its main body. In other words, the area of the cross section varies along the axial direction which corresponds to a varying size of the channel through which the electromagnetic waves propagate. Thus, the electromagnetic waves confined by the inner surface of the hollow conductor connecting member are subjected to the variations.

[0014] According to an aspect, the area of the cross section of the main body varies in a stepwise manner along the axial direction of the main body. Thus, the inner surfaces of the hollow conductor connecting member, in particular its main body, is structured in a predefined manner.

[0015] Particularly, the variation of the area of the cross section provides defined electromagnetic high frequency properties, for instance a certain damping factor and/or return loss. The structure on the inner surfaces ensures the desired properties. Accordingly, the hollow conductor connecting member and the hollow conductor system are suitable for satellite applications, for instance electromagnetic waves having a frequency higher than 4 GHz. The variation may be chosen such that a certain insertion loss and/or return loss are/is obtained.

[0016] According to an embodiment, the thickness of the main body varies along its axial direction, in particular in a stepwise manner. Thus, the hollow conductor connecting member may contact the inner surfaces of the hollow conductors substantially completely as no gaps are provided between the outer surface of the main body and the inner surfaces of the hollow conductors. The outer surface of the main body is straight. Hence, the varying area of the cross section is obtained by the varying thickness of the main body. Accordingly, the manufacturing of the hollow conductor connecting member is simplified which in turn reduces the manufacturing and assembling efforts as well as their costs.

[0017] Furthermore, the main body may have two guiding parts and an interconnecting part wherein the guiding parts are provided at the axial end portions of the main body and wherein the interconnecting part is provided between both guiding parts. Particularly, each of both hollow conductors has an inner wall which is guided by guiding surfaces provided at the outer surface of the main body. Accordingly, the guiding parts of the hollow conductor connecting member comprise the guiding surfaces. The hollow conductor connecting member is inserted into the hollow conductors or rather the hollow conductors are put on the guiding parts of the hollow conductor connecting member wherein they are guided along the guiding surfaces. Generally, the guiding parts ensure that the required mechanical stability is provided, in particular regarding bending stresses. The interconnecting part can be used for connecting the hollow conductors with the hollow conductor connecting member permanently.

[0018] Alternatively, the main body has one guiding part and an interconnecting part being adjacent to the guiding part. The interconnecting part may comprise a flange such that the hollow conductor connecting member is inserted via its guiding part such that the interconnecting part having the flange represents the axial end which is used for connection purposes.

[0019] Particularly, the interconnecting part has a protrusion extending substantially perpendicular from the outer surface of the interconnecting part. The protrusion ensures that the hollow conductors can be connected

with the hollow conductor connecting member easily as the protrusion is easily accessible when the hollow conductor connecting member is inserted into the hollow conductors. According to the alternative embodiment, the protrusion may form a flange.

[0020] According to another aspect, the protrusion is provided along the whole outer surface of the interconnecting part, particularly in a ring-shaped manner. This ensures that the hollow conductors can be connected along their complete circumference in order to provide a mechanically stable connection.

[0021] In addition, the protrusion may form a stop for the hollow conductors, in particular their face sides. The distance of insertion of the hollow conductor connecting member in the corresponding hollow conductors is predefined by the position of the protrusion. Thus, it is ensured that the predetermined structure is at the desired location ensuring the electromagnetic properties intended.

[0022] According to another embodiment, the connecting member comprises several main bodies, in particular wherein the main bodies each have a protrusion and wherein the main bodies are connected with each other via their protrusions. Particularly, hollow conductor bundles can be connected with only one hollow conducting member. Thus, one connecting member can be used to interconnect several hollow conductors, for instance four (2x2), six (3x3) or more. The weight of the hollow conductor system can be reduced accordingly wherein a stable connection is still ensured.

[0023] For instance, at least two hollow conductor bundles are provided which each comprise at least two hollow conductors separated from each other by a common intermediate wall. A lightweight hollow conductor system is achieved as several hollow conductors are provided in a hollow conductor bundle being formed in one piece. A hollow conductor bundle comprises at least two hollow conductors being adjacent to each other wherein they are separated by a common intermediate wall. Accordingly, a multi-beam hollow conductor system can be established easily wherein only three different parts may be necessary that have to be connected with each other, in particular two hollow conductor bundles and a hollow conductor connecting member having more than one main body.

[0024] The connecting member may be formed in one piece. Thus, a mechanically stable hollow conductor connecting member is established. Furthermore, the manufacturing costs can be reduced.

[0025] According to another aspect, the hollow conductors and the connecting member are connected to each other mechanically and/or chemically, in particular by welding, soldering, brazing, adhering, screwing and/or riveting. Depending on the shape of the hollow conductor connecting member, in particular its protrusion, a certain connecting type is preferred.

[0026] The area of the cross section of the main body, in particular its guiding parts, may be smaller than the

area of the cross section of the hollow conductors. Thus, the hollow conductor connecting member can be inserted into the hollow conductors due to its shape, in particular the smaller area of its cross section.

[0027] According to an embodiment, the hollow conductor connecting member comprises a flange. For instance, the hollow conductor connecting member has a flange at an axial end wherein the hollow conductor connecting member is inserted into the hollow conductor via its opposite axial end. The hollow conductor connecting member comprises at least one main body wherein the area of the cross section of the main body varies along the axial direction. Particularly, each hollow conductor bundle has a corresponding hollow conductor connecting member with a flange wherein both hollow conductor connecting members are connected with each other via their flanges. The hollow conductor system is established by contacting and connecting the flanges.

[0028] Alternatively, the hollow conductor connecting member may be formed in one piece with the corresponding hollow conductor, in particular at its face side. Particularly, the flange is part of a hollow conductor bundle comprising several hollow conductors.

[0029] Generally, the flanges can be connected with each other mechanically and/or chemically, in particular by welding, soldering, brazing, adhering, screwing and/or riveting.

[0030] The one piece construction of the hollow conductor connecting member and the corresponding hollow conductor only distinguishes from the other embodiment having separately formed hollow conductor connecting members in that the hollow conductor connecting members are integrally formed at the face sides of the corresponding hollow conductors. In contrast thereto, the separately formed hollow conductor connecting member(s) and the hollow conductors have to be connected to each other after the insertion step.

[0031] The invention will now be described with reference to the accompanying drawings. In the drawings,

- Figure 1 shows a hollow conductor system according to the state of the art,
- Figure 2 shows a hollow conductor system according to a first embodiment of the invention in a first cross sectional view,
- Figure 3 shows the hollow conductor system of Figure 1 in a second cross sectional view being perpendicular to the one of Figure 2,
- Figure 4 shows a hollow conductor bundle having three hollow conductors,
- Figure 5 shows a hollow conductor connecting member according to the invention for establishing a hollow conductor system according to the invention,

- Figure 6 shows a hollow conductor connecting member according to the invention for establishing a hollow conductor system according to the invention, and

- 5 - Figure 7 a hollow conductor system according to another embodiment of the invention in a cross sectional view wherein the hollow conductor connecting members of Figures 5 and 6 are used.

10 **[0032]** In Figure 1, a hollow conductor system 10' according to the state of the art is shown which comprises two hollow conductors 12', 14' and a hollow conductor connecting member 16' being an H-plane bend, for instance.

15 **[0033]** As shown in Figure 1, the hollow conductor connecting member 16' has a main body 18' and two guiding parts 20', 22' which surround the rectangular shaped hollow conductors 12', 14'.

20 **[0034]** The guiding parts 20', 22' each have guiding surfaces 24', 26' for the hollow conductors 12', 14' which are formed by the inner surfaces of the hollow conductor connecting member 16', in particular the inner surfaces of the guiding parts 20', 22'.

25 **[0035]** The guiding parts 20', 22' surrounding the hollow conductors 12', 14' have a larger cross section with respect to the hollow conductors 12', 14' and the main body 18' having substantially the same cross section as the hollow conductors 12', 14'. This ensures that the hollow conductor system 10' has a continuous cross section even though the hollow conductor connecting member 16' is interconnected between both hollow conductors 12', 14'. Accordingly, defined electromagnetic high frequency properties are maintained.

30 **[0036]** The hollow conductor system 10' is established by inserting the hollow conductors 12', 14' into the hollow conductor connecting member 16', in particular the guiding parts 20', 22'. Afterwards, the different parts are connected with each other by brazing, for instance.

35 **[0037]** With respect to Figures 2 to 7, a hollow conductor system, a hollow conductor system as well as a method for forming a hollow conductor system according to the invention are described wherein the same reference signs for the same or equivalent parts are used without apostrophe.

40 **[0038]** In Figure 2, a hollow conductor system 10 according to the invention is shown which comprises two hollow conductors 12, 14 and a separately formed hollow conductor connecting member 16 wherein the hollow conductor connecting member 16 is formed as a straight muffle for illustration purposes. However, the hollow conductor connecting member 16 may also be formed as an H-plane bend or an E-plane bend.

45 **[0039]** The hollow conductor connecting member 16 comprises a main body 18 which extends in an axial direction A. In general, the hollow conductor connecting member 16 can be deemed as shell-like element wherein the hollow space is used for transferring electromagnetic waves.

[0040] The main body 18 comprises two guiding parts 20, 22 which are inserted into the hollow conductors 12, 14 in the shown embodiment. Accordingly, the hollow conductor connecting member 16 has guiding surfaces 24, 26 being provided on the outer surface 28 of the main body 18, in particular the outer surface 28 of the guiding parts 20, 22.

[0041] Beside the guiding parts 20, 22, the main body 18 comprises an interconnecting part 30 being formed between the guiding parts 20, 22, in particular in the middle 31 of the main body 18. Accordingly, the guiding parts 20, 22 are provided at the axial end portions 32, 34 of the main body 18.

[0042] Thus, the main body 18 is formed axially symmetrical with respect to a middle axis intersecting the axial direction A perpendicularly wherein the middle axis runs through the middle of the hollow conductor connecting member 16, in particular the main body 18.

[0043] The interconnecting part 30 comprises a protrusion 36 which extends substantially perpendicular from the outer surface 28 of the interconnecting part 30. Accordingly, the protrusion 36 would extend radial outwardly if the main body 18 and the interconnecting part 30 had a circular cross section.

[0044] As shown in Figure 2, the protrusion 36 forms a stop 38 for each hollow conductor 12, 14, in particular the face sides of the hollow conductors 12, 14. The protrusion 36, in particular the stop 38, ensures that the hollow conductor connecting member 16 is inserted into the hollow conductors 12, 14 in a defined manner as it can only be inserted by the distance until the face side of the corresponding hollow conductor 12, 14 reaches the stop 38.

[0045] In general, the protrusion 36 is used for connection purposes such that the face sides of the hollow conductors 12, 14 are connected with the protrusion 36 in order to ensure a mechanically stable connection.

[0046] Furthermore, it is shown that the main body 18 of the hollow conductor connecting member 16 has an inner surface 40 which is structured such that the area of the cross section of the main body 18 varies along the axial direction A of the hollow conductor connecting member 16. Generally, the axial direction A corresponds to the propagation direction of the electromagnetic waves propagating through the hollow conductor system 10, in particular each of the hollow conductors 12, 14 as well as the hollow conductor connecting member 16.

[0047] The inner surface 40 is formed such that the area of the cross section of the main body 18 varies in a stepwise manner along the axial direction A. In the shown embodiment, three different structure portions 42, 44, 46 are provided wherein the first and third structure portions 42, 46 correspond to each other regarding their shape. The first and the third structure portions 42, 46 are provided at the axial end portions 32, 34 of the main body 18.

[0048] Generally, the heights and the axial lengths of the structure portions 42 - 46 are dimensioned such that defined electromagnetic high frequency properties are

provided such as a damping factor, in particular a certain insertion loss.

[0049] In the shown embodiment, the varying area of the cross section along the axial direction A, in particular the different structure portions 42 - 46, is established by a varying thickness of the main body 18. Thus, the outer surface 28 of the main body 18 abuts the inner surfaces of the hollow conductors 12, 14 completely apart from the protrusion 36.

[0050] If the main body 18 had a circular cross section, the inner diameter of the main body 18 would vary along the axial direction A of the main body 18, in particular in the shown stepwise manner. Accordingly, the main body 18 would contact the circularly formed hollow conductors 12, 14 via its outer diameter. Thus, the main body 18 would have a cylindrical shape.

[0051] Therefore, the area of the cross section along the whole hollow conductor system 10 varies along the propagation direction of the electromagnetic waves wherein the variations are provided such that defined electromagnetic properties are achieved.

[0052] In Figure 3, the hollow conductor system 10 is shown in another cross sectional view being perpendicular to the one of Figure 2. This cross sectional view represents the view in axial direction A or rather in propagation direction of the electromagnetic waves.

[0053] The stepwise formed inner surface 40 is visible, in particular the first and second structure portions 42, 44.

[0054] In Figure 4, a hollow conductor bundle 48 is shown which comprises three hollow conductors 50, 52, 54 which are formed in one piece. Accordingly, two adjacent hollow conductors 50 - 54 have a common intermediate wall 56, 58 each. The intermediate walls 56, 58 may have a very small thickness resulting in a lightweight design.

[0055] Generally, such a hollow conductor bundle 48 permits the usage of a multi-beam application since three hollow conductors 50 - 54 are bundled such that three different hollow conductor channels are formed in the integrally formed common hollow conductor bundle 48.

[0056] Such a hollow conductor bundle 48 is usually formed by extrusion. Thus, the hollow conductor bundle 48 is extruded.

[0057] In Figures 5 and 6, two hollow conductor connecting members 16 are shown which each comprise a flange 60 at one axial end.

[0058] In the shown embodiments, the hollow conductor connecting members 16 each comprise three main bodies 18 such that the hollow conductor connecting members 16 can be used for establishing a hollow conductor system 10 with the hollow conductor bundle 48 shown in Figure 4 as will be described later.

[0059] In general, each hollow conductor connecting member 16 has one guiding part 20, 22 per main body 18 at its first axial end wherein the flange 60 is provided at the opposing axial end of the main body 18 being called second axial end. The separately formed hollow conductor connecting members 16 can be inserted into the cor-

responding hollow conductors 50 - 54 of the hollow conductor bundles 48 via the dedicated guiding parts 20, 22 of the main bodies 18 of the hollow conductor connecting member 16.

[0060] Then, the hollow conductor connecting members 16 are connected with the hollow conductors 50 - 54 or the hollow conductor bundles 48.

[0061] Afterwards, both hollow conductor connecting members 16 are brought into contact with each other via their flanges 60. Since each of the hollow conductor connecting members 16 comprises the flange 60 at its axial end, both hollow conductor connecting members 16 can be contacted and connected with each other via their flanges 60 after they have been inserted into the hollow conductor bundles 48. This is shown in Figure 7.

[0062] The flanges 60 can be connected by screws and/or rivets as corresponding openings in the flanges 60 are provided.

[0063] The flanges 60 are connected with each other in order to obtain a stable connection. Thus, a connection plane E is provided being perpendicular to the axial direction A or rather the propagation direction of the electromagnetic waves (please refer to Figure 7).

[0064] As shown in Figure 7, the several main bodies 18 of each hollow conductor connecting member 16 each comprise the internal structure on their inner surfaces 40 resulting in an area of the cross section of the main body 18 which varies along the axial direction A of the hollow conductor connecting member 16. The inner surfaces 40 of each main body 18 comprise the different structure portions 42, 44, 46 wherein the second or rather middle structure portion 44 is split such that each of the hollow conductor connecting members 16 provides one half of the second or rather middle structure portion 44 as shown in Figure 7.

[0065] Nevertheless, the structure of the inner surface 40 of the main bodies 18 is formed such that the predefined electromagnetic high frequency properties are achieved as discussed with respect to the embodiment shown in Figures 2 and 3.

[0066] In general, the same advantages as discussed with respect to this embodiment can be obtained. Moreover, the hollow conductor connecting member 16 of the embodiments shown in Figures 2 and 3 can also have a flange.

[0067] Alternatively to the embodiments shown in Figures 5 to 7, a separately formed hollow conductor connecting member 16 can be provided which is used for interconnecting two hollow conductor bundles 48 as shown in Figure 4.

[0068] Such a hollow conductor connecting member 16 comprises three main bodies 18, an upper, middle and lower one respectively. Each of the main bodies 18 is formed as the one discussed with respect to Figures 2 and 3 which means that each main body 18 has two guiding parts 20, 22. Hence, the hollow conductor bundles 48, in particular their hollow conductors 50 - 54 are positioned such that they surround the guiding parts 20,

22 of each main body 18, respectively.

[0069] The protrusions 36 of each main body 18 may be connected with each other for stability purposes of the one separately formed hollow conductor connecting member 16. Thus, a hollow conductor connecting member 16 is provided being formed in one piece.

[0070] Such a hollow conductor connecting member 16 can be inserted into the hollow conductors 50 - 54 of the hollow conductor bundles 48 shown in Figure 4 in an analog manner as described with respect to the embodiment shown in Figures 2 and 3.

[0071] According to another embodiment of the hollow conductor system 10 according to the invention, each hollow conductor bundle 48 has an integrally formed hollow conductor connecting member 16 with a flange. In other words, the hollow conductors 50 - 54 and the hollow conductor connecting member 16 are formed in one piece wherein the hollow conductor connecting members 16 are provided at the face sides of the hollow conductor bundles 48 each.

[0072] Thus, a hollow conductor system 10 according to the invention can be established which comprises hollow conductor bundles 48 which contact each other via their hollow conductor connecting members 16, in particular their flanges integrally formed at the axial ends of the hollow conductor bundles 48.

[0073] This alternative embodiment distinguishes from the one shown in Figure 7 only in that the hollow conductor connecting members 16 are integrally formed with the hollow conductor bundles 48.

[0074] In general, three different hollow conductor lines can be provided by the systems according to the different embodiments wherein only two, three or four different parts have to be assembled. Thus, a lightweight design is provided which can be assembled quickly and easily. Accordingly, the manufacturing and assembling costs are reduced.

[0075] One embodiment relates to an inserting design wherein at least one separately formed hollow conductor connecting member 16 is provided that has to be inserted into the hollow conductors and connected afterwards. For instance, the hollow conductor connecting member 16 may be inserted into the hollow conductors 12, 14 or rather the hollow conductor bundles 48 comprising the hollow conductors 50 - 54.

[0076] Particularly, two hollow conductor connecting members 16 can be used which have flanges at their axial ends such that the hollow conductor connecting members 16 are connected with each other via their flanges after they have been inserted into the hollow conductors 12, 14 or the hollow conductor bundles 48 comprising the hollow conductors 50 - 54.

[0077] Another embodiment relates to a flange design wherein the hollow conductor connecting member 16 having a flange is integrally formed with the hollow conductor or the hollow conductor bundle. Thus, the hollow conductors or the hollow conductor bundles comprising the hollow conductors are connected with each other via

their integrally formed flanges.

[0078] Generally, the hollow conductor system 10 can be formed easily since the hollow conductors 12, 14 or the hollow conductors 50 - 54 formed in the hollow conductor bundles 48 are connected to each other via the hollow conductor connecting member 16, in particular their flanges 60 if provided. The hollow conductor connecting member 16 may comprise sufficient main bodies 18 for interconnecting the number of hollow conductors 12, 14, 50 - 54 provided. Usually, two hollow conductors 12, 14, 50 - 54 are interconnected via one main body 18.

[0079] The different parts, in particular the hollow conductor connecting member(s) 16 and the hollow conductors 12, 14, 50 - 54 or their flanges 60, are interconnected with each other mechanically or chemically, for instance by welding, soldering, brazing, adhering, screwing and/or riveting.

[0080] Irrespective of the design of the hollow conductor system 10, the at least one hollow conductor connecting member 16 comprises a varying inner surface 40 such that the area of the cross section of the main body 18 of the hollow conductor connecting member 16 varies along the axial direction A of the connecting member 16 resulting in predefined electromagnetic high frequency properties. In contrast thereto, the outer surface of the main body 18 might be straight. The axial direction A corresponds to the propagation direction of the electromagnetic waves which propagate along the hollow conductors which cross section varies along their propagation path.

[0081] In general, the hollow conductors 12, 14, 50 - 54 have a smaller area of the cross section in the connecting planes with respect to adjacent planes being perpendicular to the axial direction A or the propagation direction of the electromagnetic waves.

[0082] Thus, a mechanically stable, lightweight and cost-optimized hollow conductor system 10 is provided.

Claims

1. Hollow conductor connecting member (16) for connecting two hollow conductors (12, 14; 50, 52, 54) wherein the connecting member (16) comprises at least one main body (18) extending in an axial direction (A) wherein the main body (18) is configured such that it can be inserted in hollow conductors (12, 14; 50, 52, 54) at least partly wherein the area of the cross section of the main body (18) varies along the axial direction (A) of the connecting member (16).
2. Hollow conductor connecting member (16) according to claim 1, **characterized in that** the area of the cross section of the main body (18) varies in a stepwise manner along the axial direction (A) of the main body (18).
3. Hollow conductor connecting member (16) accord-

ing to claim 1 or 2, **characterized in that** the variation of the area of the cross section provides defined electromagnetic high frequency properties, for instance a damping factor.

4. Hollow conductor connecting member (16) according to any of the preceding claims, **characterized in that** the thickness of the main body (18) varies along its axial direction (A), in particular in a stepwise manner.
5. Hollow conductor connecting member (16) according to any of the preceding claims, **characterized in that** the main body (18) has two guiding parts (20, 22) and an interconnecting part (30) wherein the guiding parts (20, 22) are provided at the axial end portions (32, 34) of the main body (18) and wherein the interconnecting part (30) is provided between both guiding parts (20, 22).
6. Hollow conductor connecting member (16) according to claim 5, **characterized in that** the interconnecting part (30) has a protrusion (36) extending substantially perpendicular from the outer surface (28) of the interconnecting part (30).
7. Hollow conductor connecting member (16) according to claim 6, **characterized in that** the protrusion (36) is provided along the whole outer surface (28) of the interconnecting part (30), particularly in a ring-shaped manner.
8. Hollow conductor connecting member (16) according to claim 6 or 7, **characterized in that** the protrusion (36) forms a stop (38) for the hollow conductors (12, 14; 50, 52, 54), in particular their face sides.
9. Hollow conductor connecting member (16) according to any of the preceding claims, **characterized in that** the connecting member (16) comprises several main bodies (18), in particular wherein the main bodies (18) each have a protrusion (36) wherein the main bodies (18) are connected with each other via their protrusions (36).
10. Hollow conductor connecting member (16) according to any of the preceding claims, **characterized in that** the connecting member (16) is formed in one piece.
11. Hollow conductor system (10) comprising at least two hollow conductors (12, 14; 50, 52, 54) and at least one hollow conductor connecting member (16), in particular at least one hollow conductor connecting member (16) according to any of the preceding claims, wherein the hollow conductors (12, 14; 50, 52, 54) are connected to each other via the hollow conductor connecting member (16) wherein the hol-

low conductor connecting member (16) has a main body (18) and wherein the area of the cross section of the main body (18) varies along the axial direction (A) of the connecting member (16).

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12. Hollow conductor system (10) according to claim 11, **characterized in that** the hollow conductors (12, 14; 50, 52, 54) and the connecting member (16) are connected to each other mechanically and/or chemically, in particular via welding, soldering, brazing, adhering, screwing and/or riveting. 10
13. Hollow conductor system (10) according to claim 11 or 12, **characterized in that** the hollow conductor connecting member (16) comprises a flange (60). 15
14. Hollow conductor system (10) according to claims 11 to 13, **characterized in that** at least two hollow conductor bundles (48) are provided which each comprises at least two hollow conductors (50, 52, 54) separated from each other by a common intermediate wall (58, 60). 20
15. Method for forming a hollow conductor system (10), in particular a hollow conductor system (10) according to any of claims 11 to 14, with the following steps: 25
 - a) Providing at least two hollow conductors (12, 14; 50, 52, 54),
 - b) Providing at least one hollow conductor connecting member (16), in particular a hollow conductor connecting member (16) according to any of claims 1 to 10, wherein the hollow conductor connecting member (16) has a main body (18) and wherein the area of the cross section of the main body (18) varies along the axial direction (A) of the connecting member (16), 30
 - c) Connecting the hollow conductors (12, 14; 50, 52, 54) with each other via the at least one hollow conductor connecting member (16). 35 40

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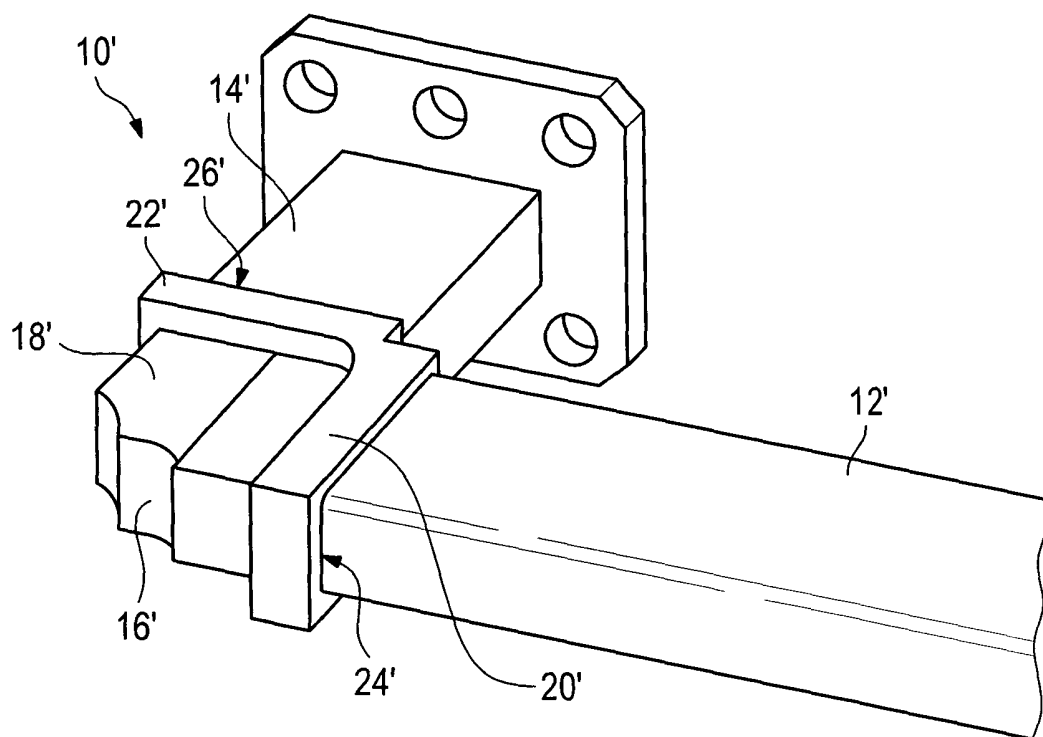


Fig. 1
(state of the art)

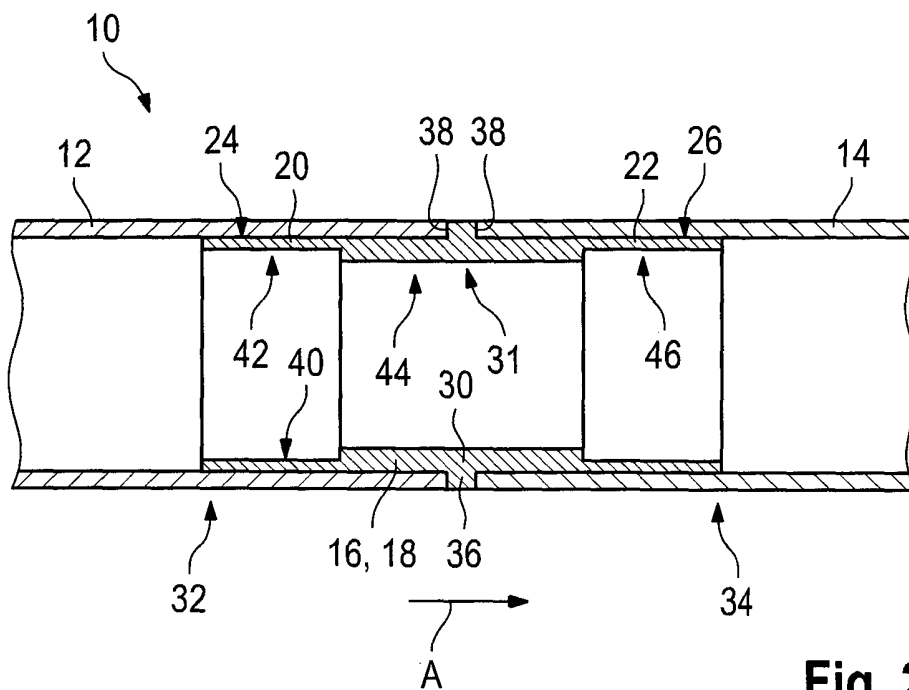


Fig. 2

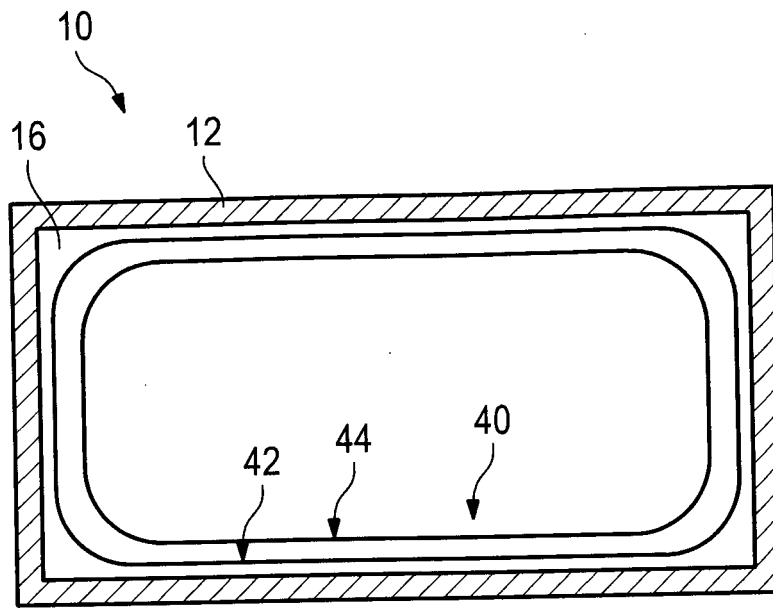


Fig. 3

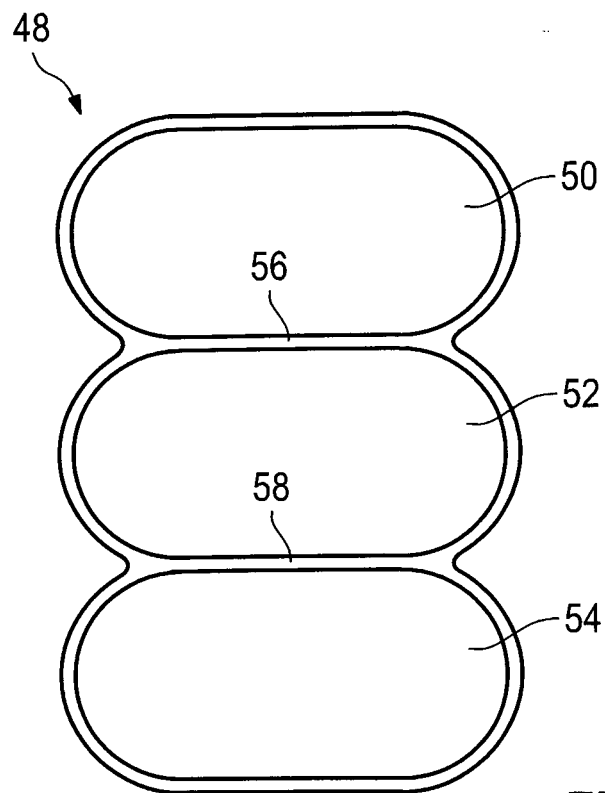


Fig. 4

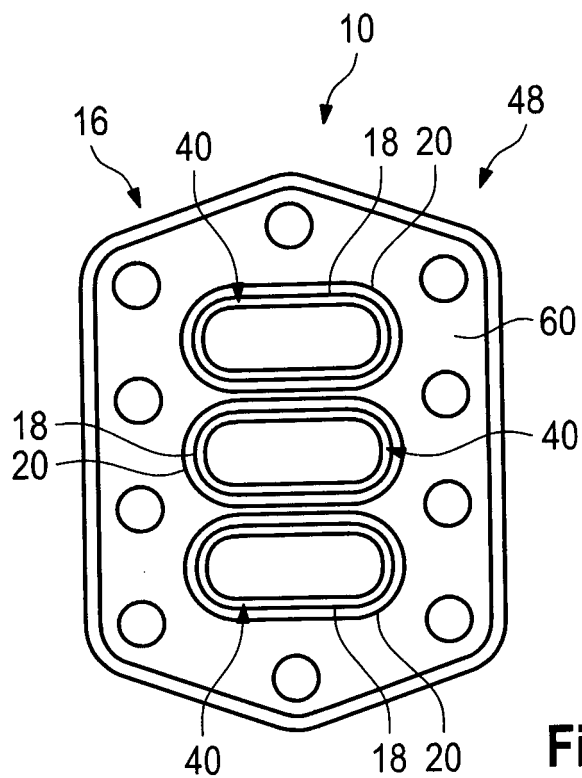


Fig. 5

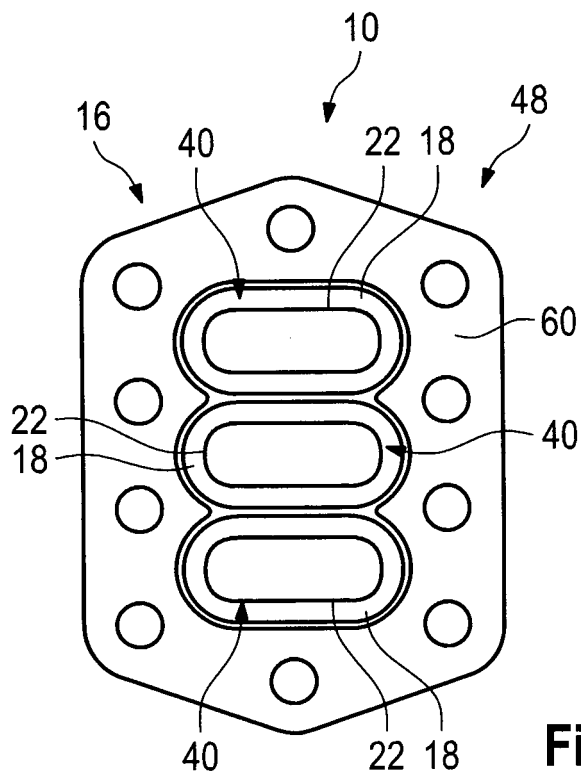


Fig. 6

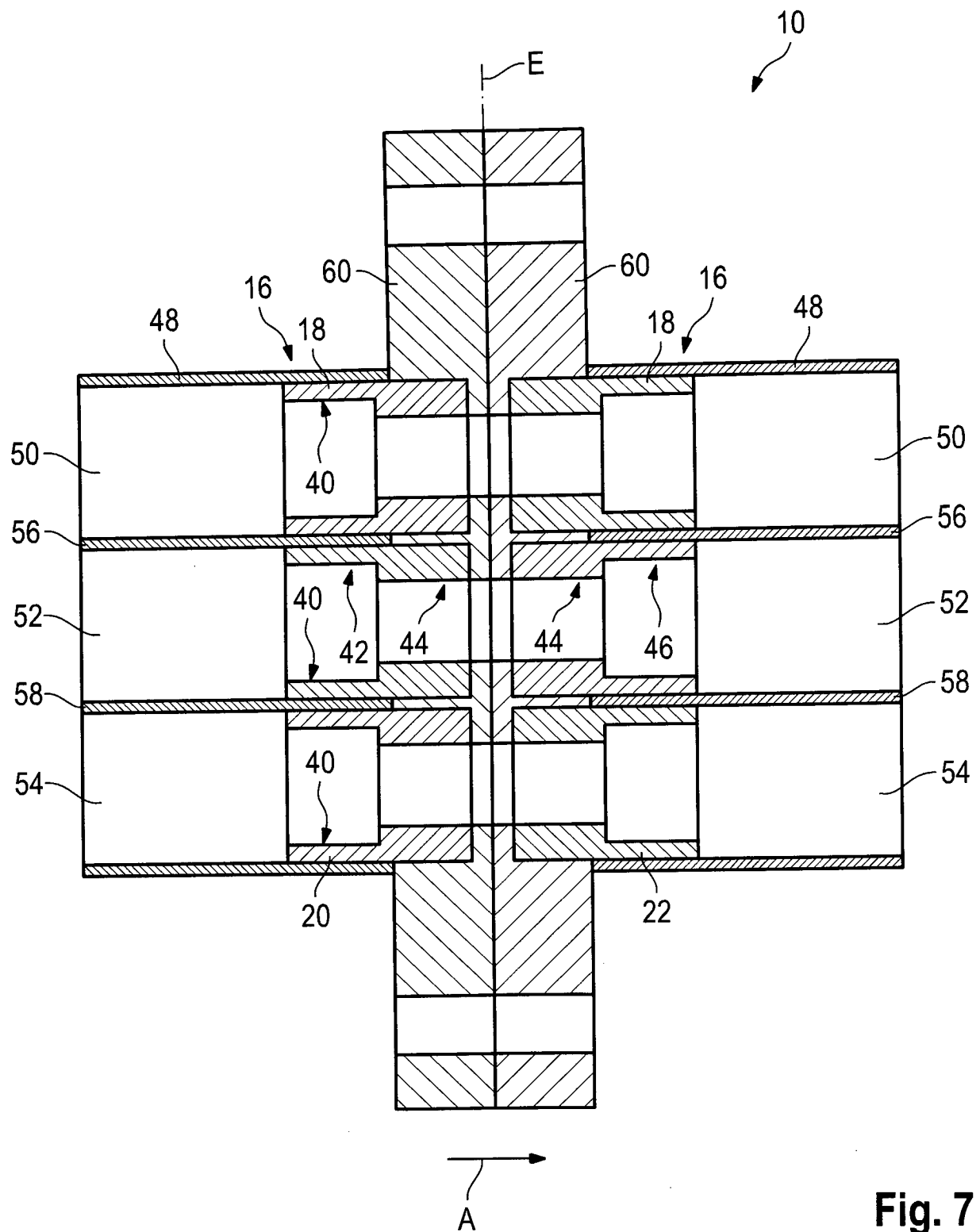


Fig. 7



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