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(54) **CONNECTOR ASSEMBLY**

(57) The invention concerns a connector assembly (1) for connecting an antenna element (2) to an antenna signal transmission line (3). The connector assembly (1) comprises an adaptor (4) comprising an antenna element attachment portion (5), a signal attachment portion (6), a ground attachment portion (8) and an impedance matching part (10). The connector assembly (1) further comprising a shielding metal cage physically connected to the adaptor (4), wherein the adaptor (4) and the metal

cage (12) form an integral part and the impedance matching part (10) comprises a slit (14) in a portion of the integral part with the signal attachment portion (6) positioned on one side (15) of the slit (14) and the ground attachment portion (8) positioned on another side (16) of the slit (14). The invention also concerns an antenna assembly and a machine or device comprising such an antenna assembly.

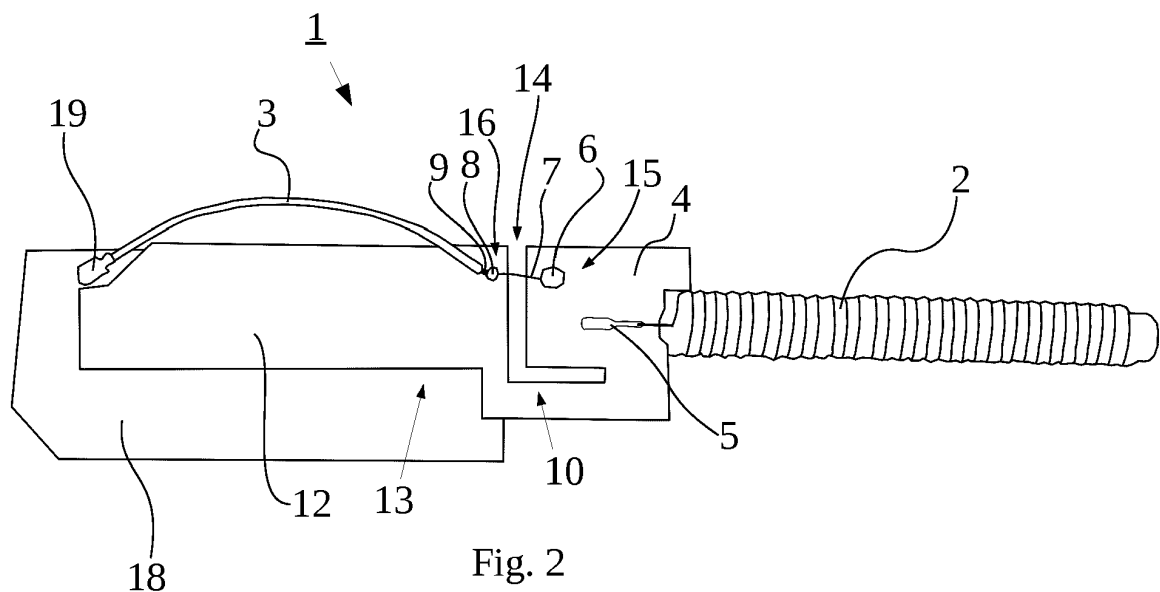


Fig. 2

Description**Field of the invention**

[0001] The invention concerns a connector assembly for connecting an antenna element to an antenna signal transmission line. Further, it also concerns an antenna assembly and a machine or device comprising such an antenna assembly.

Background art**Introduction**

[0002] In many real world devices with internal antennas, there has to be multiple integration efforts of the antenna in order for the device to comply with all electro-magnetic requisites. The antenna has to connect to the radio electronics circuits of the device with a suitable impedance and, further, the completed device must not emit unwanted radio signals, but just signals in the desired spectrum.

[0003] To this end, both an impedance match must be affected and also some shielding of the radio electronics circuits of the device that may otherwise emit unwanted radio signals themselves. For instance, the prior art of fig. 1 depicts a common solution of such a connector assembly wherein a helix antenna element 2 is connected to radio electronics circuits on a printed circuit board (PCB) 18 inside of a device (the device itself, other than the board 18, is not shown in Fig. 1).

[0004] The connector assembly 1 comprises another printed circuit board 4, acting as an adaptor 4, and a shielding metal cage 12. The cage 12 comprises sheet metal that is folded to create a cage that can cover the radio electronics circuits on the board 18. Normally, the cage would be fitted onto the board 18 and connect to the signal ground of that board 18. In Fig. 1, the cage 12 is seen from above and therefore the folds along the edges are hidden. Also, the radio electronics circuits are also not shown, since they are positioned below the cage 12 in Fig. 1.

[0005] The antenna element 2 is connected to the adaptor board 4 at an antenna element attachment portion 5 (for instance by soldering).

[0006] Further, a transmission line 3 is connected to the adaptor board 4. This connection is by way of an antenna signal conductor 7 of the transmission line 3 that is connected to a signal attachment portion 6 of the adaptor board 4 (by soldering or any other suitable means). A ground conductor 9 of the transmission line 3 (for instance a shield of a coaxial cable) is connected to the adaptor board 4 via a ground attachment portion 8 (for instance by soldering also).

[0007] On the adaptor board 4, the antenna element attachment portion 5 is in electrical connection with the signal attachment portion 6, such that the antenna element 2 is in connection with the signal conductor 7 of the transmission line 3.

[0008] Further, the adaptor board 4 comprises an impedance matching part 10 that is adapted to match the impedance of the antenna element 2 to the antenna transmission line 3. In Fig. 1, this impedance matching is shown schematically as surface mounted capacitances and coils 10 connected between the signal conductor 7 (in connection with the helix antenna element 2) and ground 8 on the adaptor board 4. In Fig. 1, ground could for instance be the whole surface of the adaptor board 4, including the ground attachment portion 8, except the parts where the antenna signals travel (items 5, 6 and 7).

[0009] Further, the adaptor 4 is physically connected to the metal cage 12, via clips 17, and the metal cage 12 is electrically connected to the ground attachment portion 8 of the adaptor 4 (also via the clips 17). In this way the cage 12 also provides an attachment point for the adaptor board 4 combined with the electrical connection between them.

Problems with prior art solution

[0010] In the antenna industry, there is always an urge to lower costs if possible and also to facilitate an easier mounting of components. In order to address this problem in view of a general integration attempt of an antenna into a device with respect to the impedance of the antenna and shielding of unwanted radio signals, the prior art of Fig. 1 for instance proposes the clips 17 as a simple means to electrically connect the cage 12 with the adaptor board 4. The clips 17 are soldered to the board 4 and clips mechanically onto the cage 12, thus any soldering on the cage is avoided while at the same time, the cage 12 provides some lateral stability to the adaptor board 4 such that possibly some attachment points for the board 4 can be avoided. In this way, the cost of the connector assembly of the prior art in Fig. 1 can be lowered.

[0011] However, the problem with the prior art design of Fig. 1 posed in this application is to reduce the cost even more while maintaining all antenna properties of the prior art design.

Summary of the Invention

Technical problem

[0012] It is an object of the present invention to propose a solution for or a reduction of the problems of prior art.

[0013] A main object is consequently to propose an improved connector assembly which is more cost effective while retaining all antenna properties.

Solution to Problem

[0014] According to the invention, this is accomplished by a connector assembly according to claim 1.

[0015] This connector assembly overcomes the above problems by getting rid of the printed circuit board, the clips and the impedance matching components all together. Instead, the cage is extended with a part corresponding to the adaptor board, making effectively the cage and adaptor board an integral, one-piece part.

[0016] Further, the transmission line with the signal and ground conductors are connected (e.g. by soldering) to this integral part together with the antenna element. This may seem like a short-circuit of the antenna transmission line and the antenna element. However, a slit is introduced in between where the signal conductor and the ground conductor is connected to the integral part. This provides enough separation to avoid a short-circuit and further *provides the impedance matching of the antenna element*.

[0017] Thus, a much simpler connector assembly is facilitated that is cheaper to produce.

[0018] The dependent claims disclose further advantageous aspects of the invention.

Brief Description of Drawings

[0019] Embodiments exemplifying the invention will now be described, by means of the appended drawings, on which:

Fig. 1 illustrates a connector assembly according to the prior art, and

Fig. 2 illustrates a connector assembly according to the invention.

Detailed description

[0020] In Fig. 2, a connector assembly 1 for connecting an antenna element 2 to an antenna transmission line 3, according to the invention is shown.

[0021] The connector assembly 1 comprises an adaptor 4 which comprises:

- an antenna element attachment portion 5, for connection of the antenna element 2 to the adaptor 4,
- a signal attachment portion 6, for connection of a signal conductor 7 of the transmission line 3 to the adaptor 4, wherein the antenna element attachment portion (5) is in electrical connection with the signal attachment portion 6,
- a ground attachment portion 8, for connection of a ground conductor 9 of the transmission line 3 to the adaptor 4,
- an impedance matching part 10, adapted to match the impedance of the antenna element 2 to the antenna transmission line 3.

[0022] The connector assembly 1 further comprises a shielding metal cage 12 for shielding radio circuits in three spatial dimensions. The adaptor 4 is physically connected to the metal cage 12 and the metal cage 12 is electrically connected to the ground attachment portion 8 of the adaptor 4.

[0023] The idea of the invention is that the adaptor 4 and the metal cage 12 form an integral part 13 with a continuous metallic surface constituting both the metal cage 12 and a surface on the adaptor 4 onto which the antenna element attachment portion 5, the signal attachment portion 6 and the ground attachment portion 8 are formed. The impedance matching part 10 comprises a slit 14 in a portion of the continuous metallic surface with the signal attachment portion 6 positioned on one side 15 of the slit 14 and the ground attachment portion 8 positioned on another side 16 of the slit 14. In this way, the impedance matching is effected without the use of lump components and also production and mounting steps are only required for one part instead of two parts of the prior art.

[0024] Generally, the slit 14 should be long enough to provide enough spacing between signal and ground, see Fig. 2. Obviously, the slit 14 cannot cut through the whole of the integral part from one side to another, since then it would no longer be an integral one-piece part.

[0025] In one embodiment of the connector assembly 1 according to the invention, the integral part 13 is made of a printed circuit board with the continuous metallic surface being a metal layer of the printed circuit board and the three

dimensional aspect of the metal cage 12 arises from metallic pins (not shown in Fig. 2) attached electrically conducting to the metal layer at distances from each other to shield radio waves. The slit 14 in the metal layer could for instance be attained by ordinary etching of the printed circuit board.

[0026] In another embodiment of the connector assembly 1 according to the invention, and as an alternative to the previous embodiment, the integral part 13 is made of a sheet metal and the three dimensional aspect of the metal cage 12 arising from at least one fold in at least a part the sheet metal. This may prove even more economical, since sheet metal is generally less expensive compared to a printed circuit board and no etching is required. The slit 14 could for instance be accomplished in the same working steps as when otherwise shaping the integral part 13 from a sheet metal.

[0027] The invention further comprises an antenna assembly comprising an antenna element 2, an antenna transmission line 3 having a signal conductor 7 and a ground conductor 9, and a connector assembly 1 according to any of the previous embodiments of the invention. The antenna element 2 is connected to the antenna element attachment portion 5 of the adaptor 4 and the antenna signal conductor 7 is connected to the signal attachment portion 6 of the adaptor 4 to form a complete antenna assembly to be built in to a device of some kind.

[0028] The invention further comprises a machine or device comprising an antenna assembly according to the invention.

Reference Signs List

1. connector assembly	12. Shielding metal cage
2. Antenna element	13. Integral part
3. Transmission line	14. Slit
4. Adaptor	15. One side of slit (14)
5. Antenna element attachment portion	16. Other side of slit (14)
6. Signal attachment portion	17. Clips
7. Antenna signal conductor	18. Radio electronics board
8. Ground attachment portion	19. Connector to radio electronics board
9. A ground conductor	
10. Impedance matching part	

Claims

1. A connector assembly (1) for connecting an antenna element (2) to an antenna transmission line (3), the connector assembly (1) comprising:

- an adaptor (4) comprising:

- an antenna element attachment portion (5), for connection of the antenna element (2) to the adaptor (4),
- a signal attachment portion (6), for connection of a signal conductor (7) of the transmission line (3) to the adaptor (4), wherein the antenna element attachment portion (5) is in electrical connection with the signal attachment portion (6),
- a ground attachment portion (8), for connection of a ground conductor (9) of the transmission line (3) to the adaptor (4),
- an impedance matching part (10), adapted to match the impedance of the antenna element (2) to the antenna transmission line (3),

the connector assembly (1) further comprising:

- a shielding metal cage (12) for shielding radio circuits in three spatial dimensions,

wherein the adaptor (4) is physically connected to the metal cage (12) and the metal cage (12) is electrically connected to the ground attachment portion (8) of the adaptor (4),

characterised in that:

the adaptor (4) and the metal cage (12) form an integral part (13) with a continuous metallic surface constituting both the metal cage (12) and a surface on the adaptor (4) onto which the antenna element attachment portion (5), the signal attachment portion (6) and the ground attachment portion (8) are formed, wherein the impedance matching part (10) comprises a slit (14) in a portion of the continuous metallic surface with the signal attachment portion (6) positioned on one side (15) of the slit (14) and the ground attachment portion (8) positioned on

another side (16) of the slit (14).

5 2. Connector assembly (1) according to claim 1, wherein the integral part (13) is made of a printed circuit board with the continuous metallic surface being a metal layer of the printed circuit board and the three dimensional aspect of the metal cage (12) arising from metallic pins attached electrically conducting to the metal layer at distances from each other to shield radio waves.

10 3. Connector assembly (1) according to claim 1, wherein the integral part (13) is made of a sheet metal and the three dimensional aspect of the metal cage (12) arising from at least one fold in at least a part the sheet metal.

15 4. Antenna assembly comprising:

- an antenna element (2),
- an antenna transmission line (3) having a signal conductor (7) and a ground conductor (9),
- a connector assembly (1) according to any of claims 1 - 3,

wherein the antenna element (2) is connected to the antenna element attachment portion (5) of the adaptor (4) and the antenna signal conductor (7) is connected to the signal attachment portion (6) of the adaptor (4).

20 5. Machine or device comprising an antenna assembly according to claim 4.

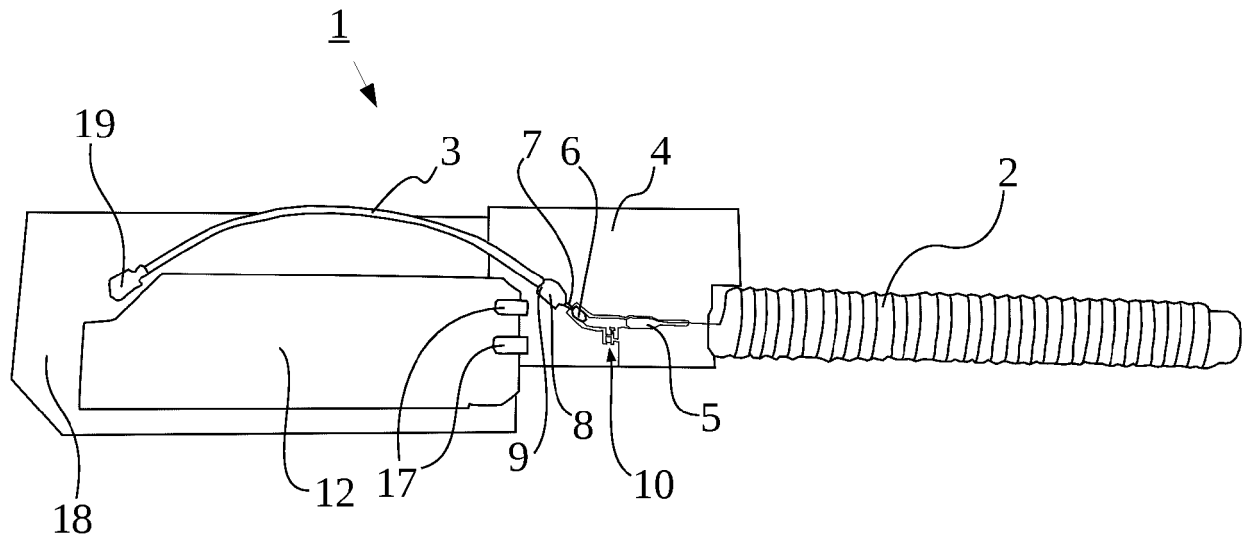


Fig. 1

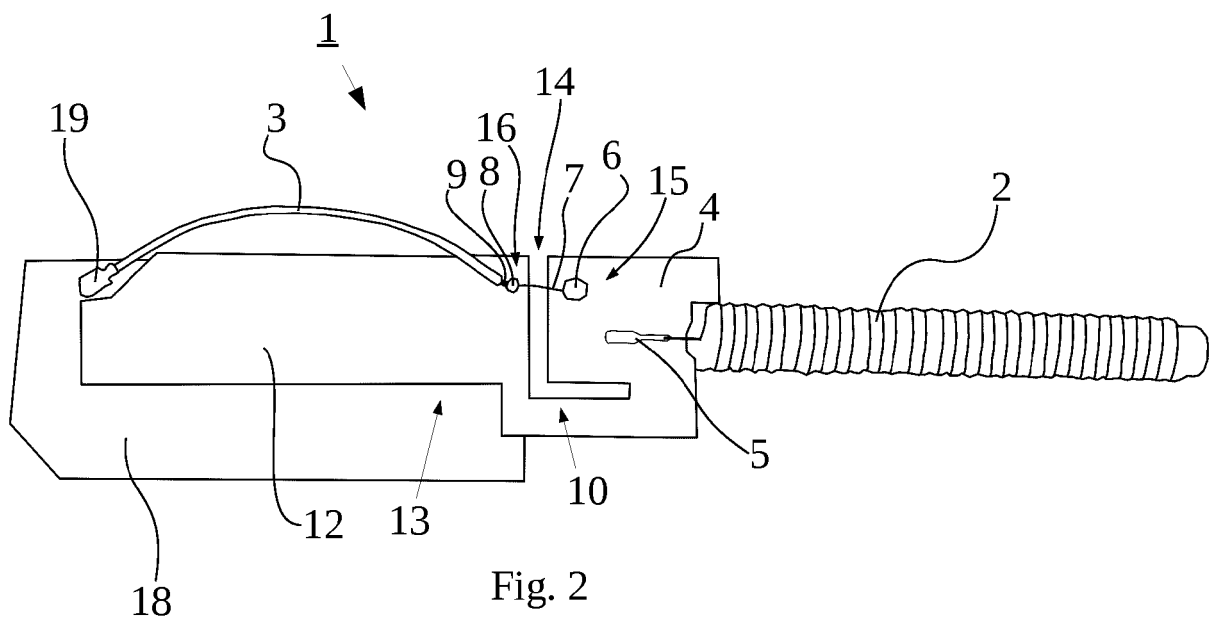


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 17 18 0314

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2004/252064 A1 (YUANZHU DOU [JP]) 16 December 2004 (2004-12-16) * figures 1-5 * * paragraphs [0018] - [0024] * -----	1-5	
			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 11 January 2018	Examiner Niemeijer, Reint
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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