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(54) **Title:** A CONNECTOR FOR AN ANTENNA DEVICE, AN ANTENNA DEVICE COMPRISING SUCH A CONNECTOR AND A PORTABLE RADIO COMMUNICATION DEVICE COMPRISING SUCH AN ANTENNA DEVICE

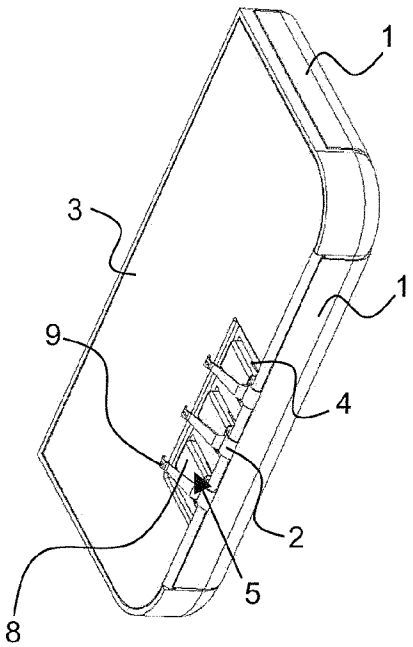

Fig. 1

(57) **Abstract:** The present invention relates to a connector for an antenna device comprising a dielectric carrier (3) and a flexible film (1) arranged on said dielectric carrier and having a radiating element arranged on one side thereof positioned against said dielectric carrier (3), characterized in that said connector comprises an upper portion (8) and a lower portion (6) foldable against each other, wherein said upper portion (8) is provided with engagement means (10, 11) for securing said upper portion (8) to said dielectric carrier (3) when mounted thereon, said lower portion (6) is arranged to be positioned between said upper portion (8) and said dielectric carrier (3) when mounted thereon and said connector is provided with resilient means (7) arranged to conductively connect to said radiating element when mounted on said dielectric carrier (3).

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A CONNECTOR FOR AN ANTENNA DEVICE, AN ANTENNA DEVICE COMPRISING SUCH A CONNECTOR AND A PORTABLE RADIO COMMUNICATION DEVICE COMPRISING SUCH AN ANTENNA DEVICE

FIELD OF INVENTION

The present invention relates generally to antennas, and particularly to a connector for an antenna device in a portable radio communication device, such as a mobile phone or similar.

BACKGROUND

The market for portable radio communication devices, such as mobile phones, PDA, portable computers and similar devices, is today very competitive, which puts tough economical demands on the manufacturers. Furthermore, antennas of such devices many times only have access to limited space of different shapes.

One crucial space limitation is the height of the antenna device that it occupies in the portable radio communication device.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a connector for an antenna device in a portable radio communication device that builds minimal height of the connector and thus also of the antenna device and consequently the portable radio communication device.

This object, among others, is according to the present invention attained by a connector, an antenna device, and a portable radio communication device, respectively, as defined by the appended claims.

By providing a connector comprising an upper portion and a lower portion foldable against each other, wherein the upper portion is provided with engagement means for securing the upper portion to a dielectric carrier of an antenna device that it is mounted on, and wherein the lower portion is arranged to be positioned between the upper portion and the dielectric carrier and is provided with resilient means arranged to conductively connect to a radiating element of the antenna device a connector building minimal height is provided.

By having the radiating element of the flexible film of the antenna device arranged towards the dielectric carrier, i.e. facing the dielectric carrier, the antenna device attain an external surface, i.e. the flexible film, having considerably better finish than with the radiating element facing out from the dielectric carrier. Further, with the radiating element between the flexible film and the dielectric carrier it is also possible to omit the step of applying a solder resist mask to the radiating element, which is applied to all surfaces apart from contact surfaces, which entails cost savings for manufacturing of the antenna device. The radiating element yet further attains a better protection against corrosion and mechanical wear, compared to when the radiating element is facing out from the radiating element.

Preferably the engagement means is arranged to be positioned in an aperture in the dielectric carrier by snap fitting in order to clamp a contact portion of the radiating element between the upper and lower portions, whereby easy mounting of the connector is provided maintaining minimal height building of the connector.

Further, the upper portion is preferably provided with a resilient means arranged to conductively connect to a printed wiring board of a portable radio communication device into which said antenna device is mounted, whereby reliable connection to the printed wiring board is provided. Also, the resilient means allows increased manufacturing tolerances.

By preferably providing the connector formed from a single sheet metal a cost effective and robust connector is formed.

Advantageously, the connector is positioned in a recess in the dielectric carrier, whereby minimal height building of the antenna device is achieved.

Preferably an antenna device for a portable radio communication device, comprising a flexible film, a radiating element, a dielectric carrier and a connector as described above is manufactured as an assembly, providing a cost effective antenna device, which further provides for a cost effective portable radio communication device.

Further features and advantages of the present invention will be evident from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description of embodiments given below and the accompanying figures, which are given by way of illustration only, and thus, are not limitative of the present invention, wherein:

Fig. 1 illustrates an antenna device having three connectors according to an embodiment of the present.

Fig. 2 shows a connector in a mounting position for the antenna device illustrated in Fig. 1.

Fig. 3 shows the connector of Fig. 2 with a contact tongue of a radiator element of the antenna device positioned therein.

Fig. 4 shows the connector of Fig. 3 half folded.

Fig. 5 shows the connector of Fig. 3 folded and snap fitted to a dielectric carrier of the antenna device.

Fig. 6 shows the connector of Fig. 5 from inside the dielectric carrier of the antenna device.

DETAILED DESCRIPTION OF EMBODIMENTS

In the following description, for purpose of explanation and not limitation, specific details are set forth, such as particular techniques and applications in order to provide a thorough understanding of the present invention. However, it will be apparent for a person skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed description of well-known methods and apparatuses are omitted so as not to obscure the description of the present invention with unnecessary details.

An embodiment of the present invention will now be described with reference to Figs. 1-6.

An antenna device for a portable radio communication device, such as a mobile phone, a PDA, a portable computer and similar device, comprises a dielectric carrier 3, a flexible film 1 arranged on the dielectric carrier 3, and a radiating element arranged on the flexible film 1 on the side of the flexible film 1 that is positioned against the dielectric

carrier 3, i.e. between the dielectric carrier and the flexible film 1. A connector 5 of the antenna device comprises an upper portion 8 and a lower portion 6 foldable against each other. The upper portion 8 is provided with engagement means 10, 11 for securing the upper portion 8 to the dielectric carrier 3 when mounted thereon. The lower portion 6 is arranged to be positioned between the upper portion 8 and the dielectric carrier 3 when mounted thereon.

When a flex-film radiator, i.e. a flexible film 1 having a radiating element thereon, is to be mounted on the dielectric carrier 3 to form an antenna device the connector 5 is first positioned on the dielectric carrier 3, Fig. 2, and a contact tongue or contact portion 2 of the radiating element is positioned on the lower portion 6 of the connector 5, Fig. 3. Thereafter the connector 5 is folded such that the engagement means 10, 11 of the upper portion 8 secures the connector 5 to the dielectric carrier 3, e.g. by snap fitting, Figs. 4-6. The flex-film radiator is preferably attached to the dielectric carrier 3 by means of an adhesive, such as a tape or glue.

The lower portion 6 is provided with resilient means 7 arranged to conductively connect to the radiating element when mounted on the dielectric carrier 3. The resilient means 7, e.g. provided as a flexible tongue punched out of the lower portion 6, extends from the lower portion 6 towards the upper portion 8, and when the upper portion 8 and the lower portion 6 are folded together the resilient means 7 is urged towards the contact tongue 2 of the radiating element, which provides for reliable electrical contact. The upper portion 8 preferably comprises a resilient means 9 for contact to a printed wiring board of the portable radio communication device, such as for

grounding or feeding the antenna device. The upper portion will preferably not have direct electrical contact with the contact tongue 2, due to the flexible film 1 on top of the radiating element. It is however also possible to provide the contact tongue 2 outside of the flexible film 1, to get direct electrical contact to both the upper portion 8 and the lower portion 6, but such a contact tongue 2 will be very sensitive for mechanical stress without the support of the flexible film 1.

If the flexible film 1 were to be provided with a radiating element also on the outside thereof the upper portion 8 of the connector can be used to connect both the inner and the outer radiating element to a common feed or a common ground.

The engagement means 7 is preferably provided by snap fitting into an aperture 4 in the dielectric carrier 3. The engagement means is e.g. provided by means of two portions of the upper portion 8 bent essentially perpendicular thereto. Each bent portion comprises a first projection 10 arranged to be pushed into the aperture 4 and locked inside the dielectric carrier 3 on a shoulder of the aperture 4, and a second projection 11 being resilient essential perpendicularly to the locking of the first projection 10. The aperture 4 is preferably shaped as a slot, having the first and second projections to lock to the inside of the dielectric carrier 3 on a shoulder of the aperture 4. Alternatively, the first and second projections and the first and second projections could protrude out of the dielectric carrier and lock to the underside of the dielectric carrier. Such a solution is preferably used when the connector 5 is positioned on the same side of the dielectric carrier as the radiating element, which position is described below.

The connector 5 is preferably formed by punching out a single shape of a sheet metal, which single shape thereafter is formed by bending the sheet metal to the desired connector.

By having the radiating element of the flexible film 1 arranged towards the dielectric carrier 3 it is further possible to mount discrete components on the radiating element, which are accommodated in indentations in the dielectric carrier, whereby they are provided together with the antenna device without increasing the height of the antenna device.

The connector 5 is illustrated as positioned in a recess in the underside of the dielectric carrier 3, or the side of the dielectric carrier opposite the side wherein the main part of the radiating element is arranged, whereby minimum height building of the antenna device is achieved. The radiating element is also illustrated with portions thereof folded down over the circumferential parts of the dielectric carrier 3. The contact tongue 2 is folded from the circumferential part into the connector 5. Further, if the radiating element does not include a folded down portion toward the connector 5 the contact tongue 2 is folded from one side of the dielectric carrier over the circumferential part into the connector 5. However, the connector 5 could alternatively be positioned on the surface of the underside of the dielectric carrier 3, with only little height building of the antenna device, but still minimal height building of the connector 5.

Although the connector 5 has been described as positioned in the underside of the dielectric element 3 opposite the side wherein a major part of the radiating element is positioned, the connector 5 could also be positioned on the same side of

the dielectric element 3 as the radiating element or be positioned on the circumferential side of the dielectric element, preferably in recesses thereof. The resilient means 9 would in such a case need to be directed in another direction, compared to when the connector 5 is positioned on the underside of the dielectric element 3.

The connector 5 has been described having a resilient means 7 in the lower portion 6 thereof. In an alternative embodiment the connector instead has an alternative resilient means in the upper portion 8 thereof, which alternative resilient means is arranged to press the contact tongue 2 towards the lower portion 6. The alternative resilient means will thereby press on the flexible film 1, which in it self will not create improved contact between the connector 5 and the radiating element, but the pressure will improve the contact between the lower portion 6 of the connector 5 and the contact tongue 2 to thereby create improve the contact between the connector 5 and the radiating element.

It will be obvious that the present invention may be varied in a plurality of ways. Such variations are not to be regarded as departure from the scope of the present invention as defined by the appended claims. All such variations as would be obvious for a person skilled in the art are intended to be included within the scope of the present invention as defined by the appended claims. The antenna device can e.g. include any desired number of connectors, each formed and arranged according to the present invention. Further, although the connector has been describe as positioned in an antenna device for a portable radio communication device, it may as well be used also for other devices such as e.g. an antenna device in a fixed

radio communication device or any other device comprising a conductive element on a dielectric carrier.

CLAIMS

1. A connector for an antenna device comprising a dielectric carrier (3) and a flexible film (1) arranged on said dielectric carrier and having a radiating element arranged on one side thereof positioned against said dielectric carrier (3), **characterized in** that said connector comprises an upper portion (8) and a lower portion (6) foldable against each other, wherein said upper portion (8) is provided with engagement means (10, 11) for securing said upper portion (8) to said dielectric carrier (3) when mounted thereon, said lower portion (6) is arranged to be positioned between said upper portion (8) and said dielectric carrier (3) when mounted thereon and said connector is provided with resilient means (7) arranged to conductively connect to said radiating element when mounted on said dielectric carrier (3).

2. The connector according to claim 1, wherein said lower portion (6) is provided with said resilient means (7).

3. The connector according to claim 1 or 2, wherein said engagement means (10, 11) is arranged to be positioned in an aperture (4) in said dielectric carrier (3) by snap fitting in order to clamp a contact portion (2) of said radiating element between said upper and lower portions.

4. The connector according to any of claims 1-3, wherein said upper portion (8) is provided with a resilient means (9) arranged to conductively connect to a printed wiring board of a portable radio communication device into which said antenna device is to be mounted.

5. The connector according to any of claims 1-4, wherein said connector is formed from a single sheet metal.

6. The connector according to any of claims 1-5, wherein said connector is arranged to be fitted into a recess in said dielectric carrier (3).

7. The connector according to any of claims 1-6, wherein the connector is arranged in a side of said dielectric carrier (3) opposite a side onto which a major part of said radiating element is positioned.

8. An antenna device for a portable radio communication device, comprising a flexible film (1), a radiating element, a dielectric carrier (3) and a connector (5), **characterized in** that said connector (5) is provided according to any previous claim.

9. A portable radio communication device comprising an antenna device according to claim 8.

10. A connector for a device comprising a dielectric carrier (3) and a flexible film (1) arranged on said dielectric carrier and having a conductive element arranged on one side thereof positioned against said dielectric carrier (3), **characterized in** that said connector comprises an upper portion (8) and a lower portion (6) foldable against each other, wherein said upper portion (8) is provided with engagement means (10, 11) for securing said upper portion (8) to said dielectric carrier (3) when mounted thereon, said lower portion (6) is arranged to be positioned between said upper portion (8) and said dielectric carrier (3) when mounted thereon and said connector is provided with resilient means (7) arranged to conductively connect to said conductive element when mounted on said dielectric carrier (3).

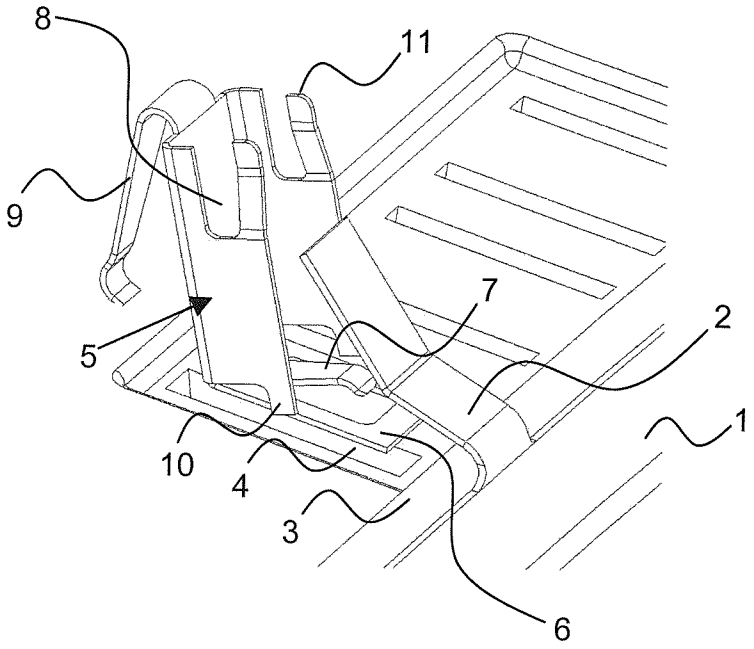

Fig. 2

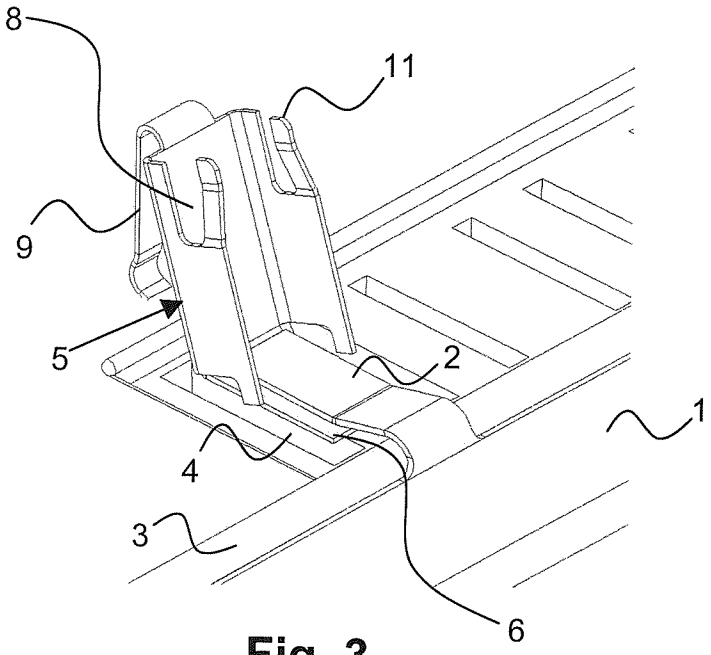

Fig. 3

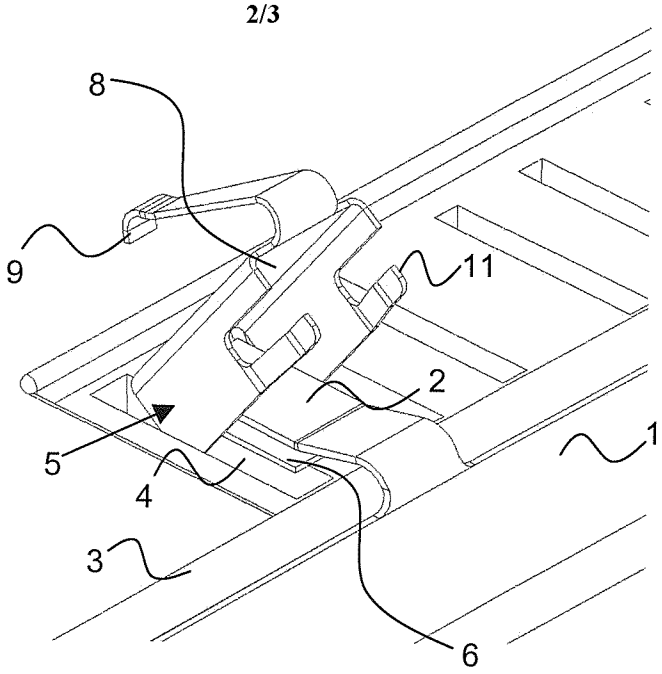

Fig. 4

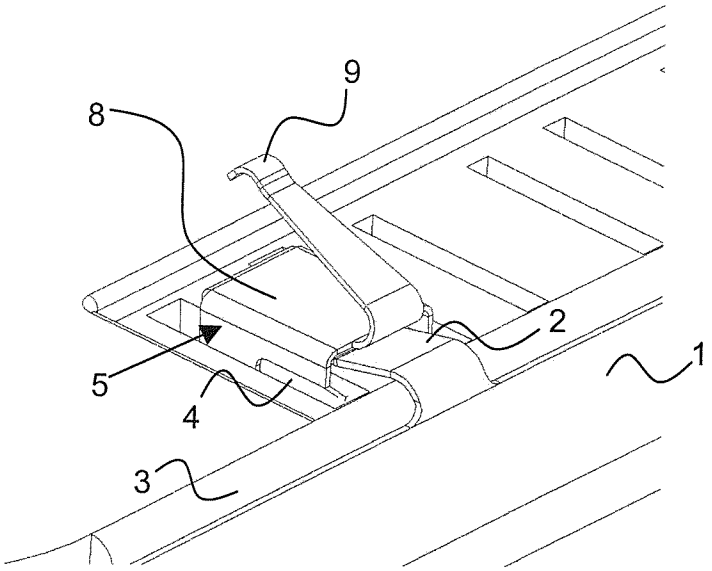

Fig. 5

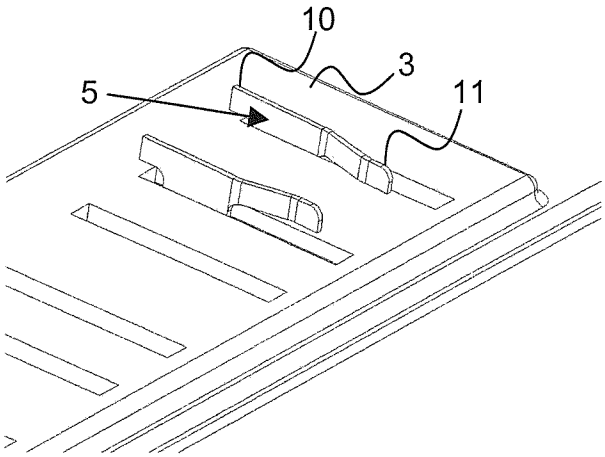

Fig. 6

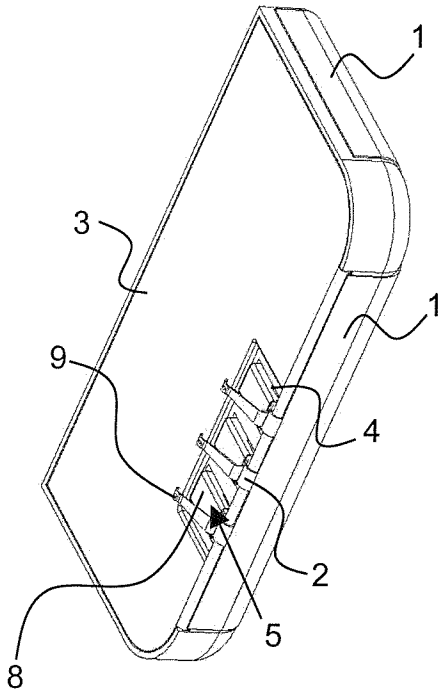

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2008/050584

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
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)

IPC: H01R, H01Q

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 102004032006 B3 (KATHREIN-WERKE KG), 20 April 2006 (20.04.2006), figure 4, abstract ---	1-10
A	US 20050112960 A1 (S. DU ET AL), 26 May 2005 (26.05.2005), figures 1-3, abstract ---	1-10
A	US 20010027033 A1 (M. FUJIMOTO ET AL), 4 October 2001 (04.10.2001), whole document ---	1-10
A	US 20040132319 A1 (M. RICHTER ET AL), 8 July 2004 (08.07.2004), figures 1-3, abstract --- --------	1-10

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Date of the actual completion of the international search	Date of mailing of the international search report
5 Sept 2008	08 -09- 2008
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Rune Bengtsson / MRo Telephone No. +46 8 782 25 00

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Cited literature, if any, will be enclosed in paper form.

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