(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 675 214 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.06.2006 Bulletin 2006/26

(21) Application number: **05112566.4**

(22) Date of filing: **21.12.2005**

(51) Int Cl.:
H01Q 9/30 *(2006.01)* ***H01Q 11/08*** *(2006.01)*
H01Q 21/28 *(2006.01)* ***H01Q 21/30*** *(2006.01)*
H01Q 1/32 *(2006.01)* ***H01Q 1/40*** *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **23.12.2004 IT VI20040306**

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(54) Vehicle multiband antenna.

(57) Vehicle multiband antenna (1; 100) suited to receive radio signals with various wave lengths, comprising a casing (2; 102) housing a plurality of reception/transmission elements (10; 110) of the radio signals, associated with different frequency bands, each of said reception/transmission elements (10; 110) being electrically connected to a circuit of electronic components (11; 111). The reception/transmission elements (10; 110) comprise one substantially helical element (3; 103) and one or more filiform elements (4; 104), each positioned inside the volume determined by the helical element (3; 103), these filiform elements (4; 104) being each one made up of a track of conductor material (4a; 104a) applied on one bearing structure (5; 105) of a substantially laminar shape and which supports the helical element (3; 103).

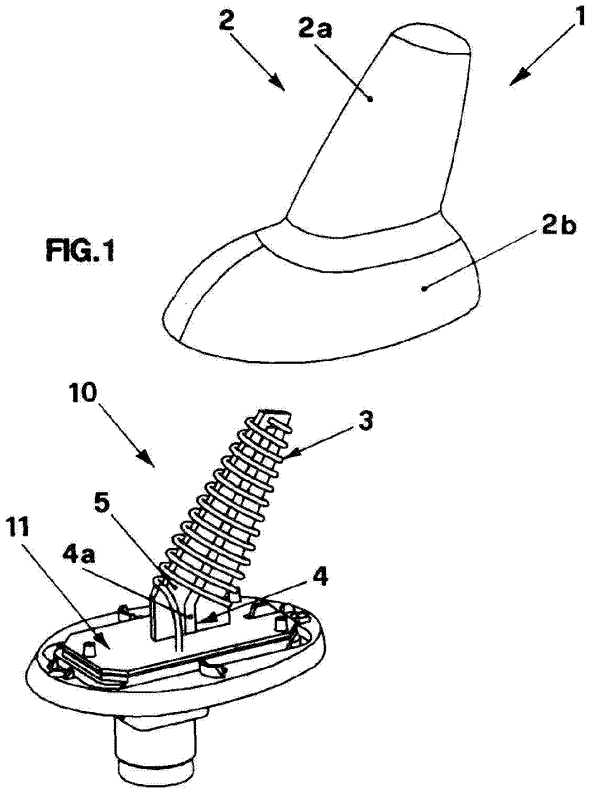

FIG.1

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Description

[0001] This invention concerns a multiband antenna for self-propelled vehicles, particularly suitable for receiving/transmitting radio signals belonging to bands of different frequencies.

[0002] It is known that there is a need to equip vehicles with antennas suited to receive/transmit signals on bands of different frequencies.

[0003] There is, indeed, an increasing demand for vehicles to be able to receive radio signals relative to various applications such as, for example, mobile telephone systems, AM radio, FM radio, satellite navigation systems, television and, more recently, digital radio or DAB (Digital Audio Broadcasting).

[0004] All these applications are characterised by the use, as the means of diffusion, of radio signals with different wave lengths, up to the extreme case of DAB which requires two radio signals with different wave lengths.

[0005] The DAB frequency bands are band III, centered around 200 MHz, and band L, centered around 1500 MHz.

[0006] As is known, in monopole antennas there is a precise correspondence between the preferred antenna length and the frequency of the signals the antenna has to receive.

[0007] This correspondence generally means that receiver antennas are used, their length being ¼ of the wave length of the signal to be received.

[0008] To provide an antenna for DAB radio signals, a 36 cm monopole is, therefore, necessary for band III and a 5 cm monopole for band L.

[0009] The monopole antennas known to background art, for receiving/transmitting radio signals relative to all the applications mentioned above, have the common features of comprising a single rod electrically associated with the receiver circuits of the signals in the various frequency bands.

[0010] One drawback of such antennas consists of the fact that each receiver circuit must contain additional electronic circuits that make up for the non-appropriate length of the receiver antenna as this may have a length that is suitable for just one frequency band.

[0011] In general, the receiver circuits for AM and FM applications use impedance adapters to simulate the missing part of the antenna, while the circuits for mobile telephone systems have part of the antenna on the printed circuit of the receiver.

[0012] To limit these hardware additions to the receiver circuits, the antenna rod is often equipped with one or more helical blocking elements that divide the antenna into parts of a required length, each part being as suitable as possible to a specific receiver circuit.

[0013] In the case of DAB, for example, the antenna has an overall length of 36 cm and is generally provided with a helical blocking element after the first 5 cm, in order to obtain an antenna for receiving band L radio signals, in the first part, and an antenna for receiving band III signals, along its entire length.

[0014] Despite this embodiment, all the antennas known to background art and described up to here present other recognised inconveniences.

[0015] A first inconvenience consists of the length of the antenna and thus of the overall dimensions which are considered excessive, especially for the most common means of locomotion, such as motor vehicles, there being an increasing tendency to reduce the length of antennas for these means.

[0016] On the other hand, technicians in this sector are generally conditioned by the prejudice whereby a compact antenna presents a performance that is too low, so that it is necessary to ensure that the appropriate antenna length is provided by a substantially linear development and with suitable lengths.

[0017] Another inconvenience, in view of what has been said so far, i.e. that background art antennas do not have the correct length for all the required applications, is the complexity of the receiver circuits due to the need to foresee the presence of impedance adapters or parts of antenna on the printed circuit, as well as the presence of a filter to extract the signal relative to just the band concerned.

[0018] The aim of this invention is to overcome all the inconveniences described above.

[0019] In particular, the first aim of the present invention is to provide a multiband antenna with compact dimensions compared to equivalent antennas belonging to the background art.

[0020] An additional aim of the present invention is to provide an antenna which, although being of small size, has a comparable performance, in receiving signals in all the frequency bands of the applications it must be used for, to the performance of antennas belonging to the background art.

[0021] Another aim of the invention is to provide a multiband antenna that does not involve any additional carrying out complexity, in the receiver circuit, with respect to the background art.

[0022] Not the last aim of the invention is to provide a multiband antenna whose carrying out complexity be lower than the equivalent antennas belonging to the background art.

[0023] These aims are achieved by a vehicle multiband antenna which, according to the first claim, is suited to receive radio signals with different wave lengths and comprises a casing housing a plurality of elements for receiving/transmitting these radio signals associated with different frequency bands, each of these receiver/transmitter elements being electrically connected to a circuit of electronic components, said antenna being characterized in that the receiver/transmitter elements comprise one essentially helical element and one or more filiform elements, each positioned at least in part inside the volume determined by said helical element, said filiform elements being each one made up of a track of conductor material applied on a substantially laminar-

shaped supporting structure that supports said helical element.

[0024] According to a preferred embodiment, the casing of the antenna consists of an upper truncated cone-shaped part and a lower dome-shaped part.

[0025] The particular embodiment of an antenna, which also receives DAB radio signals, the essentially helical element is suitable to receive a band III radio signal and it is foreseen a filiform element suited to receive band L radio signals.

[0026] The supporting structure provides, along the edges, a plurality of support housings for the helical element.

[0027] Advantageously, the helical element makes it possible to obtain a very long antenna compacted in a small space, while still maintaining an excellent reception band thanks to the volume it determines in the space.

[0028] Indeed, it is known that the dimensions of the volume determined by an antenna arranged to encircle a region of space affect the reception band, increasing it.

[0029] Another advantage is that the compact dimensions of the multiband antenna according to this invention allow it to be fitted on the outside of a motor vehicle without foreseeing, unlike similar antennas known to the background art, a removable part necessary, for example, when the vehicle enters a car wash plant.

[0030] Yet another advantage is that the vehicle multiband antenna according to the invention do not require, on the reception circuits, any additional filter, any impedance adaptation to modify the resonance frequency or any additional antenna part, all the elements being separate from each other and each forming an antenna for a specific reception circuit.

[0031] A further advantage is that the antenna in question can be integrated in a more complex antenna containing other multimedia services, such as for example mobile phone systems and signals relative to satellite navigators, all these antennas being enclosed by the same cap.

[0032] Still advantageously, since the helical element simply rests on the supporting structure, the carrying out complexity of the multiband antenna of the invention results lower than the equivalent antennas belonging to the background art, not being necessary to provide any type of anchorage of the helical element to the supporting structure.

[0033] The aims and advantages described above will become clearer on reading the description of preferred embodiments of the invention, given as non-binding examples, with reference to the attached drawings in which:

- fig. 1 represents an exploded axonometric view of the multiband antenna of the invention;
- fig. 2 represents a detail of the multiband antenna of the invention;
- fig. 3 represents an exploded axonometric view of another executive embodiment of the multiband antenna of the invention.

[0034] A particular embodiment of the vehicle multiband antenna of the invention is shown in fig. 1 in which it is indicated in general with **1** and in which it can be seen that it comprises a casing **2** housing the receiver/transmitter elements **10,** in particular a helical element **3** and a filiform element **4.**

[0035] The embodiment shown refers to an antenna for receiving DAB radio signals, but it should be pointed out that this embodiment is provided only as an example and should not be intended as binding with respect to other embodiments of the antenna of the invention comprising several receiver/transmitter elements.

[0036] The casing **2** consists of an upper part **2a** with a truncated cone shape and a substantially elliptical cross-section, and a lower part **2b** with a dome shape and also a substantially elliptical cross-section.

[0037] The cross-section of the lower part **2b** is larger than the cross-section of the upper part **2a,** since the upper part **2a** is suited to contain the body of the antenna **1,** while the lower part **2b** is suited to contain the electronic component circuits **11** associated with the antenna **1.**

[0038] In this preferred embodiment, since the antenna **1** is suited to be fitted on motor vehicles, said upper part **2a** is slightly inclined towards the rear of the vehicle itself to improve the aerodynamics and the appearance.

[0039] As far as the filiform element **4** is concerned, this consists of a metal element **4a** positioned on a supporting structure **5** which is made up of the surface of a printed circuit of which the filiform element **4a** is a microstrip of conductor material.

[0040] Said supporting structure **5** presents on its own edges **5a, 5b,** as can be seen in fig. 2, a plurality of support housings **6** placed at an equal distance one each other and suitable to receive the outer helical element **3.**

[0041] Advantageously, the presence of these support housings **6** makes it possible, during construction of the antenna **1** of the invention, to ensure the correct distance between the turns of the helical element **3.**

[0042] Still advantageously, the presence of said support housings **6** allow the supporting structure **5** to support the helical element **3** without the presence of any anchorage means such as welding or other.

[0043] Also advantageously, as can be seen in fig. 1, the volume determined by the helical element **3** constitutes the maximum overall dimensions of the antenna **1,** except for the lower part which is, however, substantially flat.

[0044] As can be seen, indeed, the filiform element **4** is supported by the surface **5** of the printed circuit and is completely inserted in the helical element **3.**

[0045] In the particular embodiment of an antenna for the reception of DAB radio signals, the outer helical element is suited to receive band III signals, while the inner filiform element is suited to receive band L signals.

[0046] As regards the support housings **6** cut in the edge of the supporting surface **5** and suited to accommodate the helical element **3,** in the preferred embodi-

ment shown in fig. 2, these are simple grooves.

[0047] In other executive embodiments, the support housings are notches or shoulders, in any case always made on the edge of the printed circuit.

[0048] In another executive embodiment, the support housings are not present.

[0049] The initial part of every antenna is electrically connected to a circuit of electronic components **11** suited to receive radio signals belonging to a specific frequency band.

[0050] Another executive embodiment of the antenna of the invention, shown in fig. 3 and indicated with **100,** presents a helical element **103** and a first filiform element **104** for the reception of DAB radio signals, and a second filiform element **108** for the reception/transmission of other services such as, for example, the television signal.

[0051] As said, the outer helical element **103** represents the maximum overall dimensions for the plurality of reception/transmission elements **110** present, with the advantage of considerably reducing the spaces taken up by these reception/transmission elements **110** which, otherwise, would either have to be arranged on a single long element, which would require blocking elements and additional adaptation circuits, or positioned separately from each other and in various points in the vehicle thus also creating an effect in terms of appearance that is not always acceptable.

[0052] Operatively, each reception/transmission element **10** of the antenna **1** receives radio signals with a predetermined wave length.

[0053] When the antenna **1** receives the radio signal, it transforms it into an electric signal that runs along the body of the antenna **1** and, by means of an electrical connection with a relative reception circuit **11** to which the antenna **1** is associated, passes the signal to the reception circuit **11.**

[0054] The latter then sends the resulting signal to an amplification circuit, not shown here, which processes the information contained in the signal itself.

[0055] According to another executive embodiment, a filiform element of the antenna acts as a "feed" for the outer helical element.

[0056] Advantageously, there is a single antenna output in this case for the at least two frequency bands involved and the signals are divided by the subsequent circuit.

[0057] On the basis of what is described above, the vehicle multiband antenna **1** of the invention achieves all the predetermined aims.

[0058] In particular, the vehicle multiband antenna of the invention achieves the aim of containing several reception/transmission elements, each suited to receive radio signals with different wave lengths and thus for different applications, in a compact casing.

[0059] The vehicle multi band antenna of the invention also achieves the aim of not causing further complexity with respect to the background art, in the various radio signal reception circuits.

[0060] Yet, the vehicle multiband antenna of the invention achieves the aim of not requiring, in any part of it, the addition of mechanical elements to make it, when necessary, removable from the body of the vehicle on which it is fitted.

[0061] Finally, the multiband antenna of the invention achieves the aim to provide a carrying out complexity lower than the equivalent antennas belonging to the background art, since the helical element rests on the supporting structure and it does not require any anchorage to said supporting structure.

[0062] In the construction stage, further modifications may be made to the vehicle multiband antenna of the invention which, although not shown in the drawings and not described, if they are included in the contents of the following claims shall all be considered as protected by this patent.

Claims

1. A vehicle multiband antenna (1; 100), suited to receive radio signals with various wave lengths, comprising a casing (2; 102) inside which a plurality of elements (10; 110) are housed for the reception/transmission of these radio signals, associated with different frequency bands, each of said reception/transmission elements (10; 110) being electrically connected to a circuit of electronic components (11; 111), **characterized in that** said reception/transmission elements (10; 110) comprise one substantially helical element (3; 103) and one or more filiform elements (4; 104), each positioned at least partly inside the volume determined by said helical element (3; 103), said filiform elements (4; 104) being each one made up of a track of conductor material (4a; 104a) applied on one bearing structure (5; 105) of a substantially laminar shape and which supports said helical element (3; 103).

2. An antenna (1; 100) according to claim 1) **characterized in that** said helical element (3; 103) is suited to receive band III radio signals.

3. An antenna (1; 100) according to claim 1) **characterized in that** at least one of said filiform elements (4; 104) is suited to receive band L radio signals.

4. An antenna (1; 100) according to claim 1) **characterized in that** at least one of said reception/transmission elements (10; 110) is suited to receive television band radio signals.

5. An antenna (1; 100) according to claim 1) **characterized in that** at least one of said reception/transmission elements (10; 110) is suited to receive radio signals in the bands used by mobile telephones.

6. An antenna (1; 100) according to claim 1) **characterized in that** said supporting structures (5; 105) present, on at least one of their edges (5a, 5b), a plurality of support housings (6) for said helical element (3; 103).

7. An antenna (1; 100) according to claim 6) **characterized in that** said support housings (6; 106) are grooves.

8. An antenna (1; 100) according to claim 6) **characterized in that** said support housings (6; 106) are notches.

9. An antenna (1; 100) according to claim 6) **characterized in that** said support housings (6; 106) are shoulders.

10. An antenna (1; 100) according to claim 1) **characterized in that** at least one of the filiform elements (4; 104) acts as a "feed" for said helical element (3; 103).

11. An antenna (1; 100) according to claim 1) **characterized in that** said casing (2; 102) consists of:

- an upper part (2a; 102a) with a truncated cone shape and a substantially elliptical-shaped cross-section;
- a lower part (2b; 102b) with a dome shape and a substantially elliptical-shaped cross-section, this cross-section being larger than the cross-section of said upper part (2a; 102a).

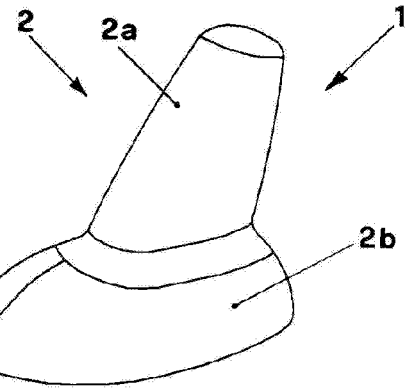
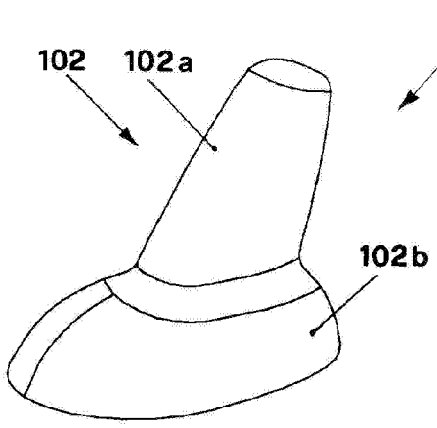
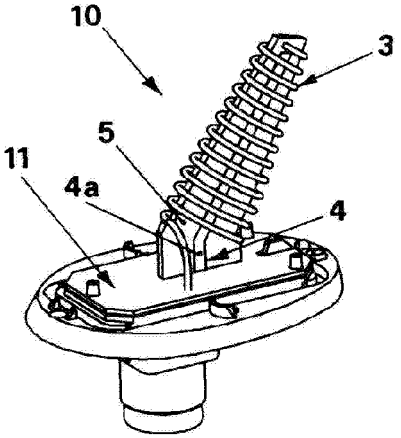


FIG.1





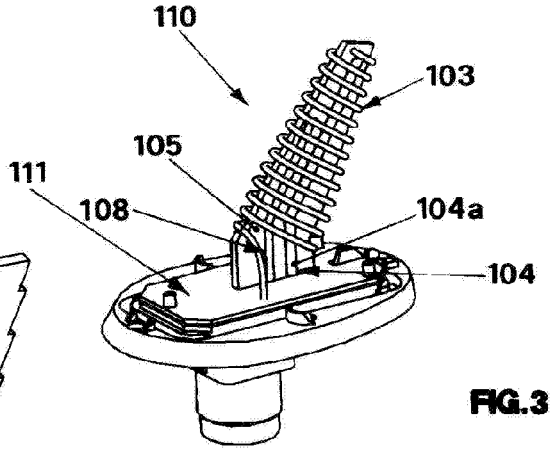


FIG.3

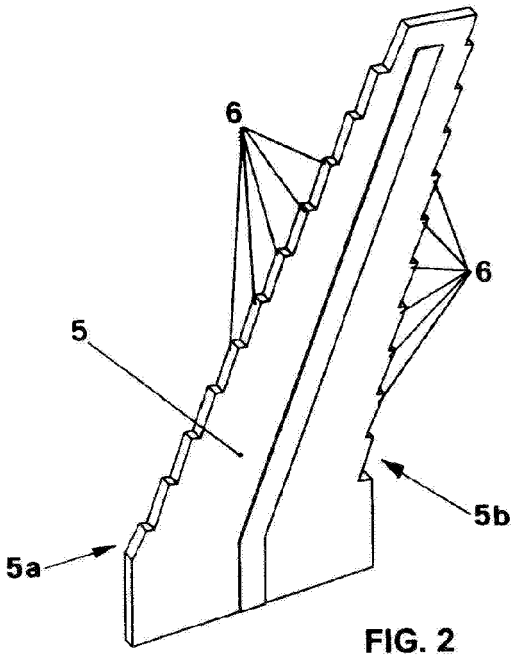


FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 11 2566

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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 6 181 296 B1 (KULISAN CHARLES W ET AL) 30 January 2001 (2001-01-30) * figure 1 *	7-9	H01Q1/40
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A	WO 2004/036686 A (CALEARO S.R.L; IACOVELLA, FEDERICO; RONZANI, ROBERTO) 29 April 2004 (2004-04-29) * abstract; figure 1 *	14	
			TECHNICAL FIELDS SEARCHED (IPC) H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 March 2006	Van Dooren, G

CATEGORY OF CITED DOCUMENTS

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