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(54) **Multiple band antenna architecture optimization**

(57) A multiband antenna comprising at least a first and a second sub-antenna, the first and the second sub-antenna respectively including a plurality of radiating elements **(12,22),** the first sub-antenna and the second sub-antenna being placed side by side, the multiband antenna further comprising a third sub-antenna, the third sub-antenna including at least a first radiating element **(32)** and a second radiating element **(32),** the first radiating element **(32)** being disposed concentrically with regards to a radiating element **(12)** of the first sub-antenna and the second radiating element **(32')** being disposed concentrically with regards to a radiating element **(22)** of the second sub-antenna.

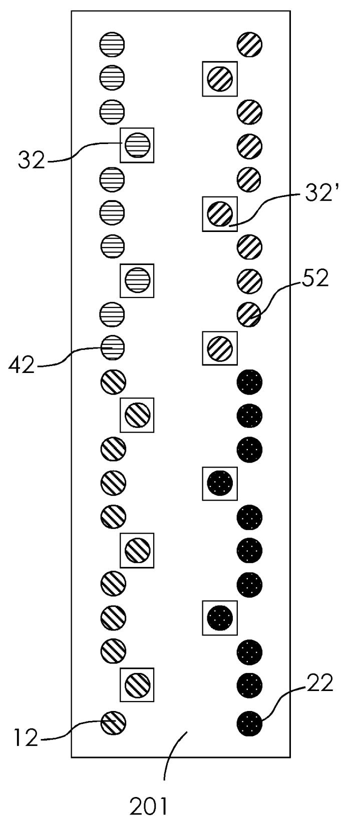

FIG.2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the technical field of multiple band antennas, and particularly to multiple band antennas architecture optimization.

BACKGROUND OF THE INVENTION

[0002] A multiple band (known also as multiband) antenna is generally formed by a set of single antennas, also referred as "sub-antennas", each one of this single antenna being able to radiate (i.e. to transmit) or receive radio waves in a specific frequency band. Indeed, for a multiband antenna the different sub-antennas are conjugated/combined in one antenna, while maintaining as much as possible each sub-antennas performance, for instance efficiency or gain associated to each sub-antenna. As non-limitative example, a multiband antenna may be a panel antenna comprising three dual-polar antennas/sub-antennas, for instance a low band antenna (ex: 698-960 MHz band) used by radio technologies such as LTE, GSM or UMTS, a high band antenna (ex: 1710-2170 MHz band) used by radio technologies such as DCS or UMTS and an ultra-broadband high band (ex: 2300-2690 MHz band) antenna used by radio technologies such as DCS, PCS, UMTS, AWS, WiMAX or LTE.

[0003] While multiband antennas are already deployed on cell sites, operators are currently looking for a solution permitting to replace the existing ones by new antennas in order to upgrade the cell sites. For instance, a mobile operator may want to integrate a new radio technology in a new frequency band, such as WiMAX/LTE on a dual-polarized panel antenna supporting only GSM and DCS/UMTS radio technologies. This situation involves various technical challenges. Indeed, the upgrade should have no impacts on existing sub-antennas performances (ex: gain, efficiency), while the total antenna form factor should remain the same, in order to minimize constraints such as visual pollution, costs or wind-load. This means that in such multiband antenna, radiating elements of each sub-antenna should be physically very close, while at the same time each sub-antenna radiation should not have major impact on other sub-antennas performances.

[0004] In order to answer these technical challenges, various architectures are commonly used, for instance when considering a multiband antenna comprising at least two sub-antennas:

- a first approach is to place each sub-antenna side-by-side following the x-axis direction (azimuth) ;
- another known approach is to place each sub-antenna one above the other following the y-axis direction (elevation) ;
- another known approach is to place the radiating elements of a first sub-antenna concentrically inside the radiating elements of a second sub-antenna.

[0005] It is also possible to combine the above described configurations. However, such combinations generally imply that radiating elements are shared between the sub-antennas with using a duplexer. In this case, the frequency bands of the antennas should be different, which is a disadvantage if mobile operators need to apply antenna algorithms such as MIMO (multiple-input and multiple-output).

[0006] Moreover, when the number of sub-antennas in a multiband antenna is growing, the use of any of such combinations remains limited because of the low space dimensions of multiband antennas.

SUMMARY OF THE INVENTION

[0007] Various embodiments are directed to addressing the effects of one or more of the problems set forth above. The following presents a simplified summary of embodiments in order to provide a basic understanding of some aspects of the various embodiments. This summary is not an exhaustive overview of these various embodiments. It is not intended to identify key of critical elements or to delineate the scope of these various embodiments. Its sole purpose is to present some concepts in a simplified form as a prelude to the more detailed description that is discussed later.

[0008] One object of the present invention is to provide a solution to the aforementioned problems, and offers other advantages over the prior art. Another object of the present invention is to propose a simple architecture dedicated to multiband antennas while maintaining performances unchanged.

[0009] Another object of the present invention is to increase the number of sub-antennas in a multiband antenna, while keeping the multiband antenna form factor constant.

[0010] Another object of the present invention is to provide a multiband antenna compliant with antennas algorithms such as those of MIMO antenna systems.

[0011] Various embodiments relate to a multiband antenna comprising at least a first and a second sub-antenna, the first and the second sub-antenna respectively including a plurality of radiating elements, the first sub-antenna and the second sub-antenna being placed side by side, the multiband antenna further comprising a third sub-antenna, the third sub-antenna including at least a first radiating element and a second radiating element, the first radiating element being disposed concentrically with regards to a radiating element of the first sub-antenna and the second radiating element being disposed concentrically with regards to a radiating element of the second sub-antenna.

[0012] In accordance with a broad aspect, the third sub-antenna includes a plurality of radiating elements, the first radiating element and the second radiating element being successive radiating elements in this third sub-antenna.

[0013] In accordance with another broad aspect, in this multiband antenna

- the first sub-antenna is formed by a first set of at least two sub-antennas, the at least two sub-antennas of the first set being disposed one above the other and including respectively a plurality of radiating elements ;
- the second sub-antenna is formed by a second set of at least two sub-antennas, the at least two sub-antennas of the second set being disposed one above the other and including respectively a plurality of radiating elements.

[0014] While the various embodiments are susceptible to various modification and alternative forms, specific embodiments thereof have been shown by way of example in the drawings. It should be understood, however, that the description herein of specific embodiments is not intended to limit the various embodiments to the particular forms disclosed.

[0015] It may of course be appreciated that in the development of any such actual embodiments, implementation-specific decisions should be made to achieve the developer's specific goal, such as compliance with system-related and business-related constraints. It will be appreciated that such a development effort might be time consuming but may nevertheless be a routine understanding for those or ordinary skill in the art having the benefit of this disclosure.

DESCRIPTION OF THE DRAWING

[0016] The objects, advantages and other features of various embodiments will become more apparent from the following disclosure and claims. The following non-restrictive description of preferred embodiments is given for the purpose of exemplification only with reference to the accompanying drawing in which

- Figure 1 is a schematic diagram illustrating an architecture for a multiband antenna according to various embodiments;

- Figure 2 is a schematic diagram illustrating an architecture for a pentaband antenna according to various embodiments.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0017] With reference to figure 1, an architecture for a multiband antenna is proposed according to one embodiment. In this embodiment, a multiband antenna **101** comprises three sub-antennas.

[0018] It is to be noted that in the entire document, for drawing simplification, radiating elements with a same graphical representation within a same multiband antenna refers to a same set of radiating elements forming a sub-antenna and also to a same numerical reference.

[0019] Each first, second and third sub-antenna comprises, respectively, a fixed number of radiating elements (for instance dipole elements) **11, 21, 31/31'** and operates (i.e. transmit or receive signals) respectively in a first, second and third frequency band. The first and second sub-antennas, with their respective radiating elements **11** and **21,** are disposed side by side, while taking into account the limited dimensions (width, height) of the multiband antenna **101.** The radiating elements **31** and **31'** refer to successive radiating elements within the third sub-antenna.

[0020] In one embodiment, each radiating element **31** and its successive radiating element **31'** in the third sub-antenna are disposed alternately and concentrically with regards of the radiating elements **11** and **21** of the first and second sub-antennas.

[0021] By concentric elements is meant, herein, separated elements disposed spatially so that having a common center (ex: an element disposed as an outside/external or inside/internal element with regard to another element).

[0022] By "disposed alternately and concentrically", is meant here, that

- a radiating element **31** in the third sub-antenna is disposed concentrically with regard to a radiating **11** element of the first sub-antenna ;

- its successive radiating element **31'** in the third sub-antenna is disposed concentrically with regard to a radiating element **21** of the second sub-antenna.

[0023] For instance, in one embodiment, as represented on figure 1, the radiating elements **31/31'** of the third sub-antenna are used successively as "outside", i.e. as external concentric elements, whereas the "inside" i.e. internal concentric elements (with regards to the radiating elements **31/31')** are alternately the radiating elements **11** and **21** of the first and second sub-antennas. Indeed, the radiating elements **11** and **21** of the first and second sub-antennas are disposed in such a way, that some (i.e. a predetermined number of) radiating elements **11** of the first sub-antenna and some radiating elements **21** of the second sub-antenna are arranged alternately and concentrically "inside" (i.e. as internal elements with regard to) the radiating elements **31** and their successive radiating elements **31'** of the third sub-antenna.

[0024] Alternatively, in another embodiment, each radiating element **31** and its successive radiating element **31'** in the third sub-antenna may be disposed alternately as "inside", i.e. as internal, concentric elements with regard to the radiating elements **11** and **21** of the first and second sub-antennas. Indeed, any other combination could be also considered. For instance, each radiating element **31** and its successive radiating element **31'** in the third sub-antenna may be also used alternately as "inside" or "outside" elements in view of the radiating elements **11** and **21.** Such combinations may depend on radiating elements parameters considerations such as dimensions or radiating performances.

[0025] Moreover, in one embodiment, in order to maximize the performances, such as gain, of each sub-antenna or/and to minimize interferences between sub-antennas (or between specific radiating elements) the radiating elements of a same sub-antenna may not be necessarily aligned. Indeed, some radiating elements of sub-antennas placed side by side may be aligned, except the ones which may be concentrically disposed (i.e. having a common center) with regards to radiating elements of another sub-antenna.

[0026] For instance, as illustrated on figure 1, the non-concentric radiating elements **11** or **21** of the first or second sub-antenna may be aligned, whereas the concentric elements of these sub-antennas and each radiating element **31** and its successive radiating elements **31'** in the third sub-antenna (which are disposed concentrically) may be shifted, with regards of aligned radiating elements included in the first or second sub-antenna. This may permit to maximize each sub-antenna performances such as gain or/and minimize interferences.

[0027] In one embodiment, in order to minimize interferences and increase decoupling between sub-antennas, each element of the i^{th} sub-antenna (where i=1,2 or 3) is placed at distance expressed in terms of a wavelength λi with regard to the other elements, wherein λi is the wavelength at central frequency of the sub-antenna i.

[0028] As non limitative example, with reference to Figure 1 and in order to maximize performances:

- the "vertical" distance between the centers of each non-concentric element and its successive non-concentric element within the first (and second) sub-antenna may be comprised between 0.5λi and 1 λi (where i=1 or 2) ;
- the "vertical" distance between the centers of each concentric element **31** and its successive concentric element **31'** within the third sub-antenna may be comprised between 0.5 $\lambda 3$ and 1 $\lambda 3$;
- the "horizontal" distance between the centers of each concentric element **31** and its successive concentric element **31'** within the third sub-antenna may be inferior to 0.25$\lambda 3$, in order to optimize its radiation pattern ;
- the "horizontal" distance between the centers of each concentric element and its successive non-concentric element within the first (and second) sub-antenna may be inferior to 0.25λi (where i=1,2) ;
- the "horizontal" distance between the first sub-antenna and the second sub-antenna, may be maximized in order to increase their decoupling i.e. to decrease their interactions.

[0029] It can be understood, that even a same number of radiating elements **11** and **21** are represented on figure 1, the respective number of these radiating elements is not necessarily equal. Indeed, the number of radiating elements **11, 21** may be different, in condition that they can be used alternately as concentric elements with regards to each radiating element **31** and its successive radiating element **31'.**

[0030] It is also understood that, in order to facilitate the present description, only three sub-antennas are represented on figure 1, although obviously more than three sub-antennas could be also considered. For instance, in an alternative embodiment, there may be a set of more than two sub-antennas placed side by side, with respective radiating elements. In this configuration, another sub-antenna could be used, in such a way that its successive radiating elements would be disposed alternately and concentrically "inside" or "outside" the respective radiating elements of the set of sub-antennas placed side by side.

[0031] In one embodiment, the previous described embodiments can be combined with a "stacked design", in order to increase the number of sub-antennas inside the multiband antenna. Such embodiment is illustrated in figure 2 with taking as example a pentaband antenna **201.**

[0032] The pentaband antenna **201** comprises five sub-antennas, each one respectively operating in a frequency band and including a fixed number of radiating elements **12, 22, 32/32', 42, 52.** The first and second sub-antennas, with their respective radiating elements **12, 22,** are placed side by side. The fourth and fifth sub-antennas with their respective radiating elements **42, 52,** are placed side by side to each other and respectively above (i.e. forming a "two-level stacked design") the first and second sub-antennas with their respective radiating elements **12, 22.** The radiating elements **32** and **32'** refers to successive radiating elements in the third sub-antenna. The radiating elements **32** and **32'** of the third antenna are placed in such a way, that each radiating element **32** and its successive radiating element **32'** is concentric (e.g. used as "outside" or "inside" element), alternately with regards to the respective radiating elements **12, 22, 42, 52** of the first, second, fourth and fifth sub-antennas. This means that

- on a "first level" of the "stacked design" formed by the first and second sub-antennas, the radiating elements **12** and **22** are alternately and concentrically arranged, for instance as internal elements, in view of each radiating element **32** and its successive radiating element **32'** in the third sub-antenna ;
- on a "second level" of the "stacked design" formed by the fourth and fifth sub-antennas, the radiating elements **42** and **52** are alternately and concentrically disposed, for instance as "inside" elements, in view of each radiating element **32** and its successive radiating element **32'** in the third sub-antenna.

[0033] Indeed, since the first and fourth (respectively the second and fifth) sub-antennas are disposed one above the other, this configuration could be also seen, as a configuration of two sub-antennas placed side by side, each one being respectively formed by a set of two sub-antennas:

- the first set comprising the first and fourth sub-antennas;
- the second set comprising by the second and fifth sub-antenna;
- the two sub-antennas respectively formed by each set of two sub-antennas, being disposed side by side, as the first and second sub-antennas represented on figure 1.

[0034] In another embodiment, the third sub-antenna may be also formed by a third set of sub-antennas, for instance two or more, the sub-antennas forming the third set being disposed one above the other and including a plurality of radiating elements **32** with their successive radiating elements **32'.**

[0035] Advantageously, the described embodiments are fully compliant with mobile operator's requirements. For instance, the existing triple band antennas currently installed on cell sites, deal generally with one GSM sub-antenna (frequency band: 800-960 MHz) and two DCS/UMTS sub-antennas (frequency band: 1710-2200 MHz). In order to upgrade cell sites, currently some mobile operators idea is to replace these triple band antennas and integrate new frequencies band such as WiMAX/LTE (frequency band: 2300-2700 MHz), but also duplicate the number of high band antennas (i.e. DCS/UMTS/WiMAX/LTE sub-antennas) in order to support antenna algorithms such as MIMO algorithms and improve data rate. This means that one GSM sub-antennas and four DCS/UMTS/WiMAX/LTE sub-antennas are to be integrated in one. Hence, various technical challenges are at the same time to keep the same antenna form, integrate five sub-antennas instead of three and guarantee at least antenna performances unchanged, for instance in term of gain. Whereas architectures of the prior art are not sufficient to integrate five sub-antennas in one while taking into account multiband antennas dimension constraints, the use of a pentaband antenna such as the one disclosed in figure 2 is appropriate. Indeed, such embodiments permit to increase the number of sub-antennas in limited dimensions multiband antennas.

[0036] The described embodiments are of course not limited to a pentaband antenna comprising five sub-antennas. Indeed, such could be also applied to any multiband antenna with no limitation in number of frequencies and whatever a radiating element of a sub-antenna is.

[0037] For instance, in one embodiment a multiband antenna may be formed of:

- a first set of more than two sub-antennas placed side by side, each sub-antenna including a plurality of radiating elements ;
- more than "two levels" of sub-antennas forming a stacked design: each sub-antenna of the first set may be formed of (i.e. may be sub-divided in) a second set of sub-antennas, the second set comprising more than two sub-antennas (with their respective radiating elements) each one being placed one above the other ;
- a specific sub-antenna with its radiating elements disposed alternately and concentrically with regards to the respective radiating elements of sub-antennas of the first set of sub-antennas placed side by side.

[0038] In another embodiment, the specific sub-antenna may be also formed by a third set of sub-antenna, each sub-antenna being disposed one above the other and/or side by side and including a plurality of radiating elements.

[0039] Moreover, in order to support antennas algorithms such as MIMO algorithms, two sub-antennas or more may operate in a same band of frequency (ex: DCS/UMTS/LTE).

[0040] It is also to be noted that, although GSM/DCS/UMTS/WiMAX/LTE are considered in this document, other frequency band associated to other wireless networks could be also considered (ex: LTE Advanced).

[0041] Advantageously, the described embodiments permit to increase the number of sub-antennas forming a multiband antenna in a very limited space. The use of such a multiband antenna brings performances very close to individual antennas panels, which is fully compliant with MIMO systems. Indeed, it is possible to combine the input of the sub-antennas, leading to one antenna with improved gain performances. Moreover, such embodiments may be applied to any kind of array antennas.

Claims

1. A multiband antenna comprising at least a first and a second sub-antenna, the first and the second sub-antenna respectively including a plurality of radiating elements **(12,22),** the first sub-antenna and the second sub-antenna being placed side by side, the multiband antenna further comprising a third sub-antenna, the third sub-antenna including at least a first radiating element **(32)** and a second radiating element **(32'),** the first radiating element **(32)** being disposed concentrically with regards to a radiating element **(12)** of the first sub-antenna and the second radiating element **(32')** being disposed concentrically with regards to a radiating element **(22)** of the sec-

ond sub-antenna.

2. The multiband antenna according to claim 1, wherein the third sub-antenna includes a plurality of radiating elements, the first radiating element **(32)** and the second radiating element **(32')** being successive radiating elements in this third sub-antenna.

3. The multiband antenna according to claim 1 or 2, wherein

   - the first sub-antenna comprises a first set of at least two sub-antennas, the at least two sub-antennas of the first set being disposed one above the other and including respectively a plurality of radiating elements **(12,42) ;**
   - the second sub-antenna comprises a second set of at least two sub-antennas, the at least two sub-antennas of the second set being disposed one above the other and including respectively a plurality of radiating elements **(22,52).**

4. The multiband antenna according to claim 3, wherein the third sub-antenna comprises a third set of at least two sub-antennas, the at least two-sub-antennas of the third set being disposed one above the other and including a plurality of radiating elements **(32,32').**

5. The multiband antenna according to any of claims 1 to 4, wherein in the third sub-antenna

   - the first radiating element **(32)** is disposed concentrically as an external radiating element with regards to the radiating element **(12)** of the first sub-antenna ;
   - the second radiating element **(32')** is disposed concentrically as an external radiating element with regards to the radiating element **(22)** of the second sub-antenna.

6. The multiband antenna according to any of claims 1 to 4, wherein in the third sub-antenna

   - the first radiating element **(32)** is disposed concentrically as an external radiating element with regards to the radiating element **(12)** of the first sub-antenna ;
   - the second radiating element **(32')** is disposed concentrically as an internal radiating element with regards to the radiating element **(22)** of the second sub-antenna.

7. The multiband antenna according to any of claims 1 to 4, wherein in the third sub-antenna

   - the first radiating element **(32)** is disposed concentrically as an internal radiating element with regards to the radiating element **(12)** of the first sub-antenna ;
   - the second radiating element **(32')** is disposed concentrically as an internal radiating element with regards to the radiating element **(22)** of the second sub-antenna.

8. The multiband antenna according to any of claims 1 to 7, wherein the radiating element **(12)** of the first sub-antenna and the first radiating element **(32)** of the third sub-antenna, are shifted with regards to other radiating elements included in the first sub-antenna, said other radiating elements included in the first sub-antenna being aligned.

9. The multiband antenna according to any of claims 1 to 8, wherein the radiating element **(22)** of the second sub-antenna and the second radiating element **(32')** of the third sub-antenna, are shifted with regards to other radiating elements included in the second sub-antenna, said other radiating elements included in the second sub-antenna being aligned.

10. The multiband antenna according to any of claims 1 to 9, wherein at least two sub-antennas are operating in a same frequency band.

11. The multiband antenna according to claim 10, wherein a sub-antenna operates in a GSM frequency band.

12. The multiband antenna according to claim 10, wherein a sub-antenna operates in a DCS frequency band.

13. The multiband antenna according to claim 10, wherein a sub-antenna operates in an UMTS frequency band.

14. The multiband antenna according to claim 10, wherein a sub-antenna operates in a LTE frequency band.

15. The multiband antenna according to claim 10, wherein a sub-antenna operates in a WiMAX frequency band.

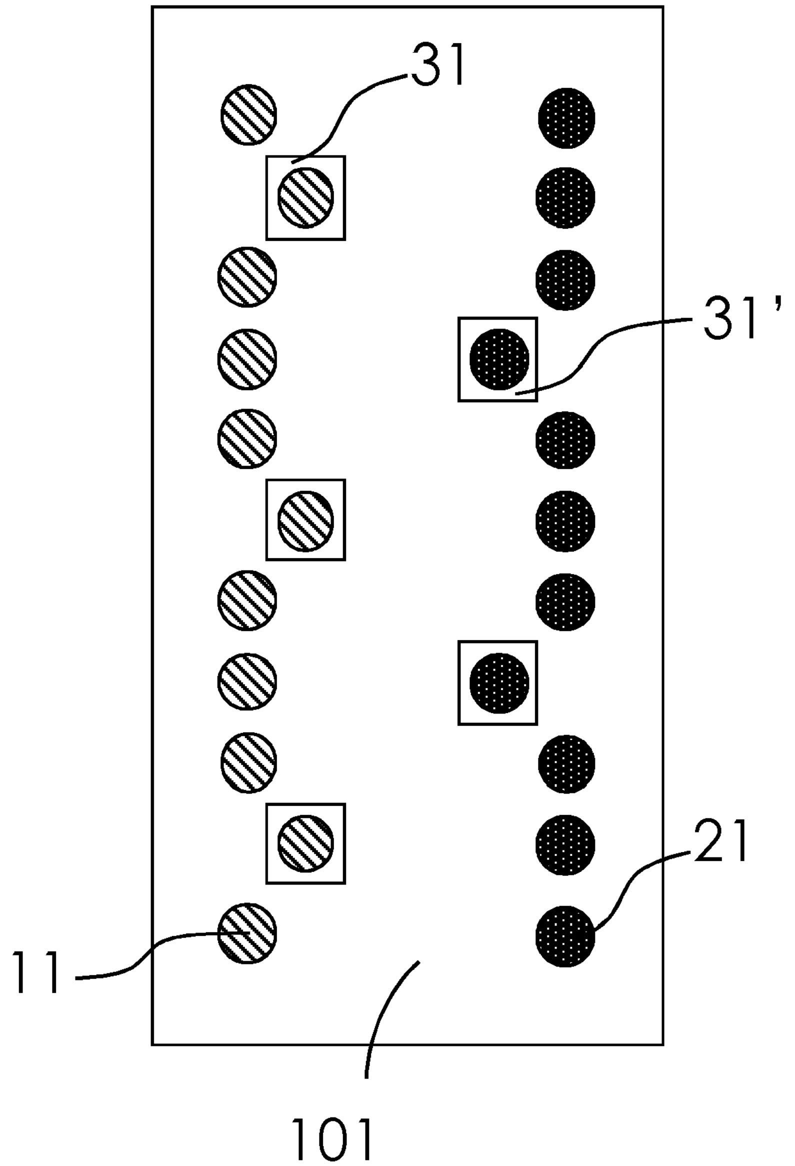

FIG.1

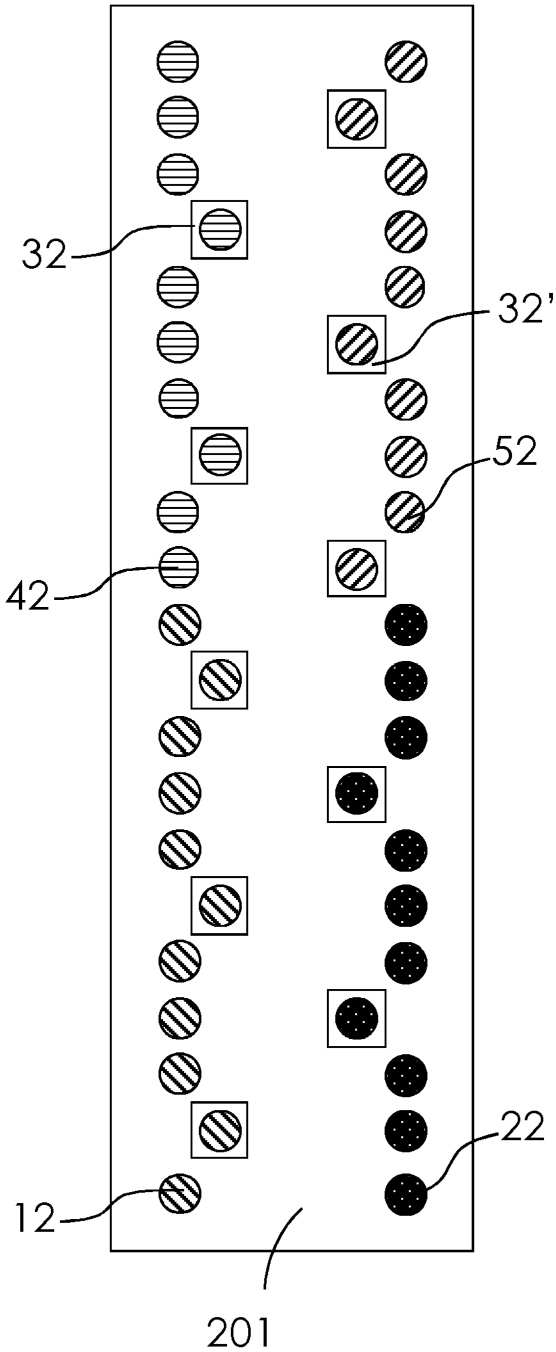

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 13 30 6897

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	COMAN C I ET AL: "A Deterministic Solution to the Problem of Interleaving Multiple Sparse Array Antennas", RADAR CONFERENCE, 2005. EURAD 2005. EUROPEAN OCT. 6, 2005, PISCATAWAY, NJ, USA,IEEE, 6 October 2005 (2005-10-06), pages 263-266, XP010910866, DOI: 10.1109/EURAD.2005.1605610 ISBN: 978-2-9600551-3-9 * the whole document * -----	1-15	INV. H01Q5/00 H01Q21/28 H01Q25/00
A	EP 1 227 545 A1 (FRACTUS SA [ES]) 31 July 2002 (2002-07-31) * abstract * * paragraphs [0021], [0022]; figure 3 * -----	1-15	
X	ABBASPOUR-TAMIJANI A ET AL: "An affordable millimeter-wave beam-steerable antenna using interleaved planar subarrays", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 51, no. 9, 1 September 2003 (2003-09-01), pages 2193-2202, XP011100505, ISSN: 0018-926X, DOI: 10.1109/TAP.2003.816331 * abstract * * paragraphs [000I], [0III]; figure 6 * -----	1-10	TECHNICAL FIELDS SEARCHED (IPC): H01Q

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	24 April 2014	van Norel, Jan

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 30 6897

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24-04-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1227545 A1	31-07-2002	AT 248443 T	15-09-2003
		AU 1046700 A	08-05-2001
		BR 9917541 A	13-08-2002
		CN 1379922 A	13-11-2002
		DE 69910847 D1	02-10-2003
		DE 69910847 T2	08-07-2004
		DK 1227545 T3	27-10-2003
		EP 1227545 A1	31-07-2002
		ES 2205898 T3	01-05-2004
		JP 2003513496 A	08-04-2003
		MX PA02004221 A	20-08-2003
		US 2002171601 A1	21-11-2002
		US 2005030247 A1	10-02-2005
		US 2005146481 A1	07-07-2005
		US 2008036676 A1	14-02-2008
		US 2009267863 A1	29-10-2009
		US 2011156986 A1	30-06-2011
		US 2012262359 A1	18-10-2012
		WO 0131747 A1	03-05-2001

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