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(54) ANTENNA ARRANGEMENT

(57) An antenna arrangement for a vehicle vessel or craft is provided. The antenna arrangement comprises a first antenna and a second antenna each connected to

a mast, and a mount which facilitates movement of the second antenna while maintaining the first antenna in a static position.

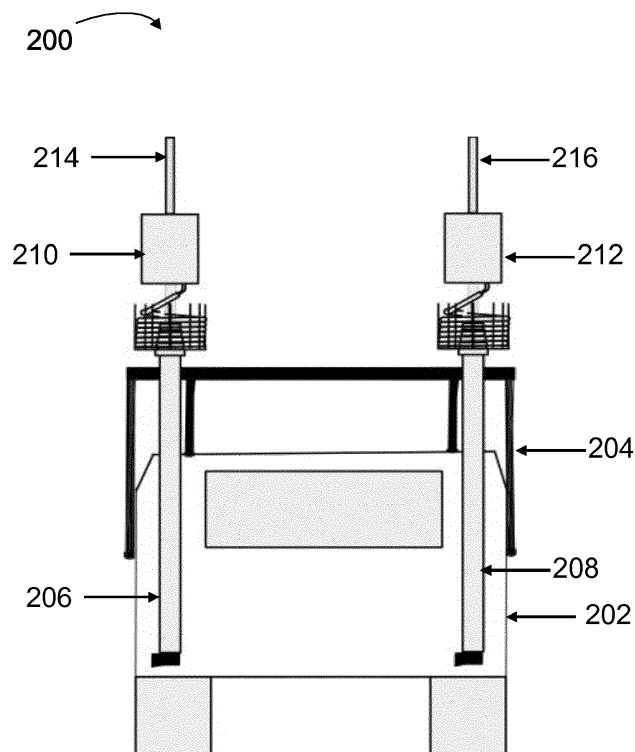


Figure 2

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Description

[0001] The present invention relates to an antenna arrangement for a vehicle vessel or craft and more particularly to an antenna arrangement for mobile communications which enables the movement of antenna while ensuring other antenna in the arrangement remain stationary.

[0002] Antenna are typically positioned in order to create specific areal coverage. Some antenna, including directional line of sight antenna, need to be adjustable in real time when the areal coverage requirement changes, particularly in mobile applications where multiple vehicles are deployed with integrated mobile communications capability and areal coverage needs to be consistently maintained. As these adjustable antenna are often co-located with other antenna which need to maintain a different areal coverage, it is a problem that the movement of the adjustable antenna results in movement of other co-located antenna and a resultant change in areal coverage. The problem is particularly acute when the co-located antenna are Long Term Evolution (LTE) or 4G antenna which need to maintain a relative position in order to ensure the Multi Input Multi Output (MIMO) capability is maintained.

[0003] It is an object of the present invention to address some of the issues highlighted above.

[0004] According to the first aspect of the invention there is provided an antenna arrangement suitable for a vehicle, vessel or craft comprising a mast, a mount attached to the mast, a first antenna rigidly attached to the mount, and a second antenna configured to be movable about at least one axis, and mounted below the first antenna, such that in use the second antenna is moveable independently of the first antenna, wherein the first antenna is substantially static with respect to the mount.

[0005] The use of a single antenna arrangement wherein movable and static antenna are arranged together means that a wide capability can be efficiently implemented on a mobile platform. This means that the areal coverage can easily be adapted to meet the requirements of the tactical location of the mobile platform. Adjustment of the areal coverage is especially important when working in a range of environments from largely unobstructed open spaces to built-up areas including urban zones.

[0006] The second antenna may be movable by rotating the mast coaxially or by additional means.

[0007] The use of a mount to support the first and second antenna allows customisation of the antenna arrangement based on the requirements of the antenna arrangement without having to customise the mast. The mount may be customised to include real-time adjustment of at least the second antenna and comprise a hollow portion or conduit for routing and protection of electronic equipment and interface equipment including wiring and cabling. The mount may be C-shaped in cross section facilitating direct alignment of the first antenna with the second antenna and coaxial alignment of the

first antenna with the mast. The mount may be L-shaped in cross section with the connections to the first antenna and the mast substantially vertically aligned. The mount may have at least one element which is configured to align the first antenna with the mast. The mount may additionally enable the height of the first antenna to be adjusted while maintaining the position of the second antenna.

[0008] Preferably, the second antenna is connected to the mount.

[0009] The mount may include features enabling adjustment of at least the second antenna around single or multiple axes and may additionally provide remote adjustment of the second antenna.

[0010] In a further arrangement a rotational platform, may be located between the mast and mount, arranged to provide rotation of the mount about the central axis of the mast.

[0011] The use of the rotational platform means that the mount may be adjustably rotated independently of the mast. The rotational platform may be remotely adjustable or manually adjustable at the rotational platform itself. The rotational platform may be used in a scanning operation and may be configured to orbit the main axis of the mast or oscillate between multiple positions.

[0012] A further rotational platform may be located between the mount and the first antenna enabling further adjustment of at least the first antenna on movement of at least the second antenna. The further rotational platform may be configured to contra-rotate with the rotational platform.

[0013] In a further arrangement the first antenna may be coaxially aligned with the central axis of the mast.

[0014] Coaxially aligning the first antenna with the central axis of the mast limits the range of movement of the first antenna to ensure that the areal coverage of the first antenna remains constant whilst still allowing the second antenna to be moveable to perform its function. The coaxial alignment allows the first antenna to be static with respect to the mast, such that it prevents the first antenna from revolving or orbiting about the main axis of the mast which is important for maintaining areal coverage.

[0015] In a further arrangement the mast may be height adjustable.

[0016] The height adjustable mast allows further adjustment of the areal coverage of all antenna that are connected to the mast. This is particularly important when operating with a directional or line of sight antenna which may need to be situated in an elevated position in order to obtain the required areal coverage. If more than one mast is used the masts may be independently adjusted to the same height or different heights depending on the areal coverage requirements.

[0017] In a further arrangement the second antenna may be attached to the mount via a tilt device, arranged to facilitate adjustment of the angle of elevation of the second antenna.

[0018] The mount may include features enabling the

tilting, twisting, rotating of the second antenna around single or multiple axes, and may additionally provide remote adjustment of the second antenna. A tilt device allows further adjustment of the areal coverage of the second antenna. This is particularly important when operating with directional or line of sight antenna.

[0019] In a further arrangement the mount may comprise an electromagnetic shield located proximate to the second antenna arranged to reduce electromagnetic interference on the second antenna.

[0020] The use of an electromagnetic shield reduces electromagnetic interference or radio frequency interference from interfering with at least the second antenna. This electromagnetic interference or radio frequency interference may originate from at least the first antenna, or from sources external to the antenna arrangement including but not limited to radio and television interference as well as interference from jamming and electromagnetic radiation detection devices.

[0021] In a further arrangement the first antenna may be an LTE antenna. The LTE antenna may be configured to provide 4G capability. The LTE antenna may be an omnidirectional antenna or it may be a sectored antenna.

[0022] In a further arrangement the first antenna may be a stacked antenna.

[0023] A stacked antenna may be used to increase the capability of the antenna arrangement including increased MIMO capacity, transmission and/or receiving wider signal frequency range with different antenna operating at different frequency ranges.

[0024] In a further arrangement the second antenna may be a directional line of sight antenna.

[0025] A directional line of sight antenna may be used to increase the capability of the antenna arrangement and may enable the antenna arrangement to be reconfigured without having to move the structure, vehicle, vessel or craft. The directional line of sight antenna may be used in a scanning operation and may be configured to oscillate between multiple positions.

[0026] In a further arrangement the antenna arrangement may comprise a further first antenna configured at a pre-defined distance from the first antenna.

[0027] The further first antenna may be free standing or connected to the same structure, vehicle, vessel or craft as the first antenna, but it may be connected to another structure including another vehicle, vessel or craft. The use of multiple antenna configured at pre-defined distances may be used to increase MIMO capacity. The co-axial alignment of the first antenna with the mast when the first antenna is paired with a further first antenna which is substantially static ensures that the separation distance remains constant when the second antenna is adjusted.

[0028] In a further arrangement the further first antenna may be fixedly attached to a further mast.

[0029] The further mast may be free standing or connected to the same structure, vehicle, vessel or craft as the mast, but it may be connected to another structure

including another vehicle, vessel or craft. The use of a further mast may be used to adjust the areal coverage of the arrangement. The adjustment of the areal coverage of the arrangement may be achieved by adjusting the height of the further mast to be the same as or different to the mast. The further mast may allow further directional LOS antenna to be adjusted to meet the areal coverage requirements.

[0030] In a second aspect of the invention there is provided an antenna system suitable for a vehicle, vessel or craft comprising two antenna arrangements as defined herein.

[0031] Multiple antenna arrangements may be integrated to enable increased areal coverage. The multiple antenna arrangements may be arranged on a structure or framework which is configured to maintain desired separation of the antenna arrangements. This framework may comprise two or more substantially vertical elements each of which may be separated by a substantially horizontal element which may be adjusted to achieve the desired separation of at least the first antenna.

[0032] In a further arrangement the first antenna on the first mast and the further first antenna on the further mast, may be located on their respective mounts, such that during use the distance between said first antenna and further first antenna is constant.

[0033] Maintaining a constant distance between the first antenna and the further antenna enables consistent performance of the antenna arrangement as the areal coverage remains constant meaning recalibration of the antenna arrangement is not required.

[0034] In a yet further aspect of the invention there is provided an antenna system suitable for a vehicle, vessel or craft comprising a first mast, a first mount attached to the first mast, a first antenna rigidly attached to the first mount, and a second antenna configured to be movable about at least one axis, and mounted below the first antenna, such that in use the second antenna is moveable independently of the first antenna,

a further mast, a further mount attached to the further mast, a further first antenna rigidly attached to the further mount, and a further second antenna configured to be movable about at least one axis, and mounted below the further first antenna, such that in use the further second antenna is moveable independently of the first antenna, wherein the first antenna is substantially static with respect to the further first antenna.

[0035] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a side perspective of an antenna arrangement according to the present invention.

Figure 2 is a rear perspective of an alternative embodiment of an antenna arrangement according to the present invention.

[0036] Referring to Figure 1, there is provided an orthogonal view of a section of an antenna arrangement suitable for a vehicle, vessel or craft. The antenna arrangement comprises a mast 102 configured to support an LTE antenna 104 providing 4G capability and a directional Line of Sight (LOS) antenna 106 mounted below the LTE antenna 104. Both the LTE antenna 104 and the LOS antenna 106 are attached to a mount 112 which is in turn connected to the mast 102. This arrangement allows the LTE antenna 104 and LOS antenna 106 to be configured to give the required areal coverage by adjusting the height of the mast 102. The LOS antenna 106 may be caused to rotate or oscillate using a rotational platform 108 located between the mast 102 and the mount 112. A tilt device 110 allows the angle of elevation of the LOS antenna 106 to be adjusted. The mount 112 is configured to position the LTE antenna 104 in coaxial alignment with the elongate central axis of the mast 102, ensuring that when the mount 112 rotates to change the areal coverage of the LOS antenna 106, that the areal coverage of the LTE antenna 104 is not affected. The antenna arrangement shown in Figure 1 also provides electromagnetic shielding 114 proximate to the LOS antenna 106 to reduce the electromagnetic interference on the LOS antenna.

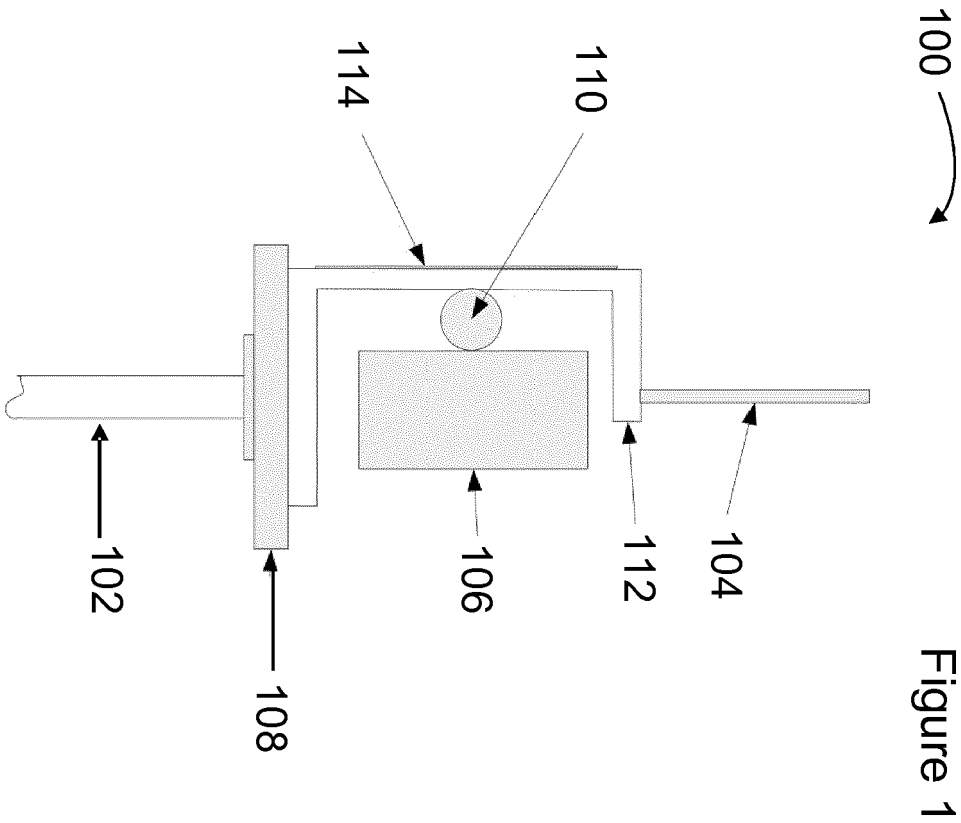
[0037] Referring to Figure 2, there is provided a rear view of an antenna system 200 comprising two antenna arrangements similar to the antenna arrangement 100 shown in Figure 1. Figure 2 shows a vehicle 202 comprising a framework 204 which is configured to support a first mast 206 and a further mast 208. Each of the first mast 206 and further mast 208 has a respective mount 210, 212, a LOS antenna (not shown) connected to the respective mount 210, 212, and a LTE antenna 214, 216 which together provide 4G areal coverage with MIMO capability. The first mast 206 and further mast 208 both comprise rotational platforms (not shown) positioned between the first mast 206 and further mast 208 and the respective mount 210, 212. The coaxial alignment of the LTE antenna 214, 216 with the respective first mast 206 and further mast 208 ensures that the distance between the LTE antenna 214, 216 remains the same on rotation of either or both rotational platforms (not shown).

Claims

1. An antenna arrangement suitable for a vehicle, vessel or craft comprising a mast, a mount attached to the mast, a first antenna rigidly attached to the mount, and a second antenna configured to be movable about at least one axis, and mounted below the first antenna, such that in use the second antenna is moveable independently of the first antenna, wherein the first antenna is substantially static with respect to the mount.
2. An antenna arrangement according to claim 1

wherein the second antenna is connected to the mount.

3. An antenna arrangement according to claim 1 or 2 further comprising a rotational platform, located between the mast and mount, arranged to provide rotation of the mount about the central axis of the mast.
4. An antenna arrangement according to any preceding claim wherein the first antenna is coaxially aligned with the central axis of the mast.
5. An antenna arrangement according to any preceding claim wherein the mast is height adjustable.
6. An antenna arrangement according to any one of the preceding claims wherein the second antenna is attached to the mount via a tilt device, arranged to facilitate adjustment of the angle of elevation of the second antenna.
7. An antenna arrangement according to any preceding claim wherein the mount further comprises an electromagnetic shield located proximate to the second antenna arranged to reduce electromagnetic interference on the second antenna.
8. An antenna arrangement according to any preceding claim wherein the first antenna is an LTE antenna.
9. An antenna arrangement according to any preceding claim wherein the first antenna is a stacked antenna.
10. An antenna arrangement according to any preceding claim wherein the second antenna is a directional line of sight antenna.
11. An antenna arrangement according to any one of the preceding claims comprising a further first antenna configured at a pre-defined distance from the first antenna.
12. An antenna arrangement according to claim 11 wherein the further first antenna is fixedly attached to a further mast.
13. An antenna system suitable for a vehicle, vessel or craft comprising two antenna arrangements according to any one of claims 1 to 10.
14. A system according to claim 13, wherein the first antenna on the first mast and the further first antenna on the further mast, are located on their respective mounts, such that during use the distance between said first antenna and further first antenna is constant.



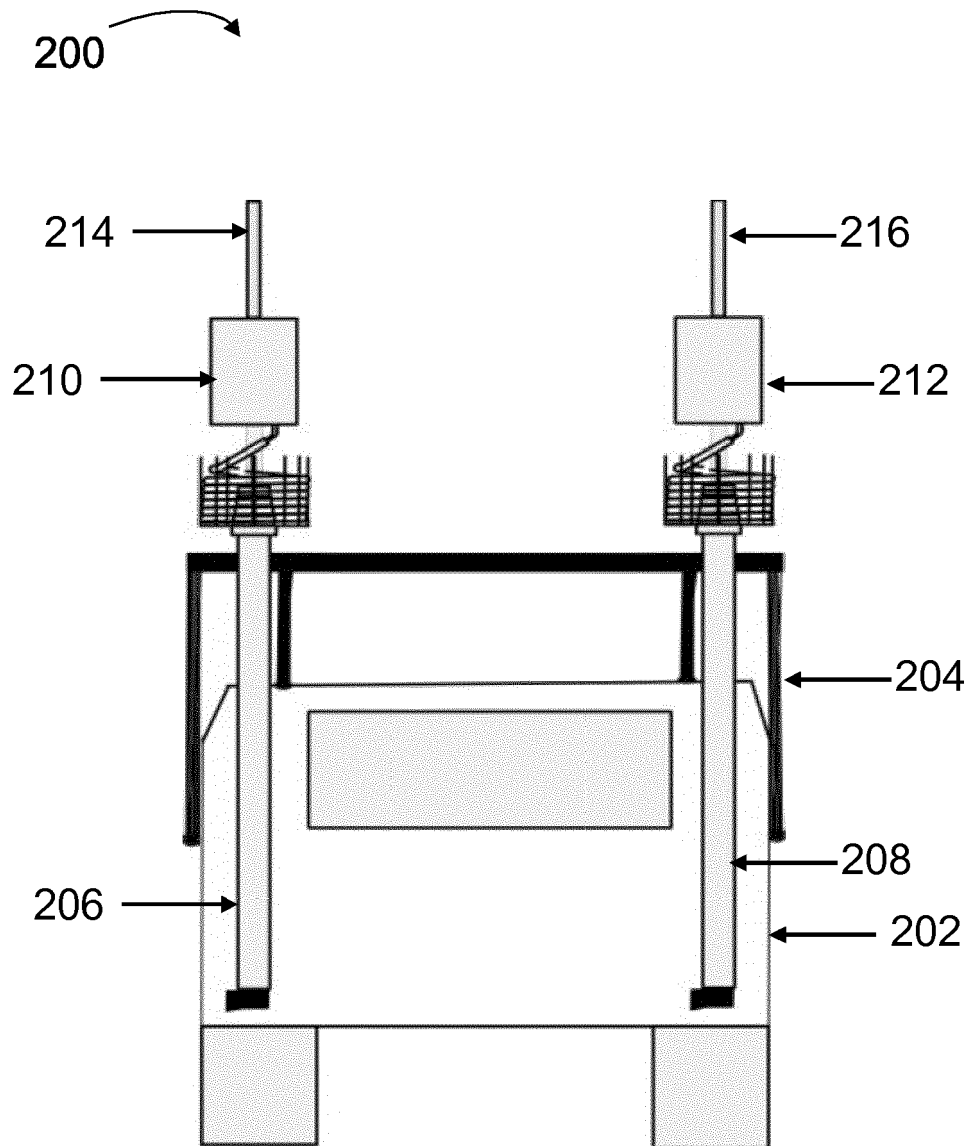


Figure 2



EUROPEAN SEARCH REPORT

Application Number
EP 17 15 2017

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 5 760 748 A (BECKINGHAM MICHAEL [NZ]) 2 June 1998 (1998-06-02) * column 4, line 64 - column 5, line 50; figure 1 *	1-14	INV. H01Q1/27 H01Q3/02 H01Q21/28
Y	US 4 491 846 A (BUSE HEINRICH [DE] ET AL) 1 January 1985 (1985-01-01) * column 3, line 1 - column 4, line 34; figures 1,2 *	1-14	
A	US 7 000 357 B1 (STEARNS CRAIG KIMBAL [US] ET AL) 21 February 2006 (2006-02-21) * the whole document *	1-14	
A	WO 94/26001 A1 (HAZELTINE CORP [US]) 10 November 1994 (1994-11-10) * the whole document *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01Q
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 July 2017	Examiner Al-Hazam, Lorens
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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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 15 2017

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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20-07-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5760748	A	02-06-1998	NONE
US 4491846	A	01-01-1985	DE 8105223 U1 10-09-1981 EP 0058893 A1 01-09-1982 JP S581303 A 06-01-1983 US 4491846 A 01-01-1985
US 7000357	B1	21-02-2006	NONE
WO 9426001	A1	10-11-1994	NONE