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(54) Title: ANTENNA ARRANGEMENT FOR A MOTOR VEHICLE WITH AN ANTENNA AND A SHIELDING DEVICE FOR ELECTROMAGNETICALLY SHIELDING AN ELECTRONIC UNIT AS WELL AS MOTOR VEHICLE

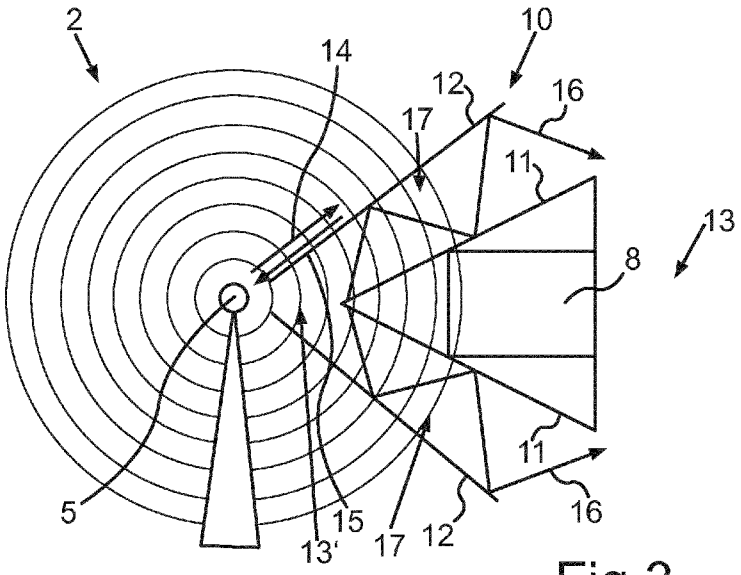

Fig.3

(57) Abstract: The invention relates to an antenna arrangement (2) for a motor vehicle (1), including an antenna (5) for emitting and/or receiving a signal, including an electronic unit (8) and including a shielding device (10) for electromagnetically shielding the electronic unit (8), wherein the shielding device (10) has a first shielding element (11), which deflects the emitted signal from a predetermined emitting direction (14) and/or deflects the signal to be received from a predetermined receiving direction (15), wherein the shielding device (10) has a second shielding element (12), which is adapted to deflect the signal (16) deflected by the first shielding element (11) into an area (13, 13'), which is shadowed for the emitted signal and/or the signal to be received by the first shielding element (11).

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Antenna arrangement for a motor vehicle with an antenna and a shielding device for electromagnetically shielding an electronic unit as well as motor vehicle

The present invention relates to an antenna arrangement for a motor vehicle including an antenna for emitting and/or receiving a signal, including an electronic unit and including a shielding device for electromagnetically shielding the electronic unit, wherein the shielding device has a first shielding element deflecting the emitted signal from a predetermined emitting direction and/or deflecting the signal to be received from a predetermined receiving direction. Moreover, the present invention relates to a motor vehicle with such an antenna arrangement.

Presently, the interest in particular directed to antenna arrangements for motor vehicles. Such antenna arrangements usually have an antenna, by means of which a signal can be emitted and/or received. For example, the antenna can serve for receiving radio signals. Further, the antenna can be used to receive data from a satellite-assisted positioning system. Moreover, the antenna can serve for emitting and/or receiving signals for providing a vehicle-to-vehicle communication or a vehicle-to-infrastructure communication.

Moreover, different electronic units for various applications are installed in motor vehicles. These electronic units can have electronic components, which generate electromagnetic radiation in the operation. In order to prevent influence of further electrical components by the electromagnetic radiation, corresponding shielding devices are used to electromagnetically shield the electronic unit. For this purpose, for example, a housing can be used for the electronic unit, which serves as a shielding unit. The signals emitted or received by the antenna are also electromagnetic waves. Since a shielding device of an electronic component would cause reflection or deflection of these electromagnetic waves, the antenna is usually disposed in a predetermined minimum distance to the electronic unit. Thus, reliable operation of the antenna with respect to emitting and receiving can be allowed.

It is the object of the present invention to demonstrate a solution, how an antenna arrangement for a motor vehicle of the initially mentioned kind can be formed in more installation space saving manner and can be reliably operated at the same time.

According to the invention, this object is solved by an antenna arrangement as well as by a motor vehicle having the features according to the respective independent claims.

Advantageous developments of the present invention are the subject matter of the dependent claims, of the description and of the figures.

An antenna arrangement according to the invention for a motor vehicle includes an antenna for emitting and/or receiving a signal. Further, the antenna arrangement includes an electronic unit. Moreover, the antenna arrangement has a shielding device for electromagnetically shielding the electronic unit. The shielding device in turn has a first shielding element deflecting the emitted signal from a predetermined emitting direction and/or deflecting the signal to be received from a predetermined receiving direction. The shielding device has a second shielding element, which is adapted to deflect the signal reflected by the first shielding element into an area, which is shadowed for the emitted signal and/or the signal to be received by the first shielding element.

The antenna arrangement can for example be disposed on an exterior trim part of a motor vehicle. The antenna of the antenna arrangement serves for emitting or receiving a signal in the form of an electromagnetic wave. For example, a radio signal, a signal of a satellite-assisted positioning system, a mobile radio signal or the like can be received as the signal. The antenna can also be adapted to transmit or receive signals for vehicle-to-vehicle communication or for vehicle-to-infrastructure communication. Moreover, the antenna arrangement has the electronic unit. The electronic unit can for example have a plurality of electronic components, which are disposed on a circuit board or a corresponding support element. In the operation of the electronic unit, these electronic components can emit electromagnetic interference signals. In order to prevent influence of further electrical components by these electromagnetic interferences, the shielding device is provided, by means of which the electronic unit is electromagnetically shielded. Now, if the antenna is disposed in a low distance to the electronic unit or to the shielding device, this entails that the shielding device also shields the signals, which are emitted by the antenna and/or are to be received by the antenna. For example, these signals formed as electromagnetic waves are reflected or deflected on a first shielding element of the shielding device. The first shielding element presents a part of the shielding device. The first shielding element can for example be at least a part of the housing of the electronic unit.

According to the invention, it is provided that the shielding device has a second shielding element, which is adapted to deflect the signal reflected by the first shielding element into an area, which is shadowed for the emitted signal and/or the signal to be received by the first shielding element. If the signal is emitted by the antenna, this area can be behind the

first shielding element starting from the antenna along the predetermined emitting direction. If the signal is to be received by the antenna, this area can be along the predetermined receiving direction between the first shielding element and the antenna. This area represents that area, in which the propagation of the emitted signal and/or the signal to be received is blocked by the first shielding element. The second shielding element is now disposed such that it deflects the signal reflected by the first shielding element into this area. The arrangement and/or dimensioning of the second shielding element can for example be determined depending on an emitting characteristic and/or receiving characteristic of the antenna. In this manner, the area, in which the emitted signal and/or the signal to be received are shadowed, can be reduced. This allows arranging the antenna in a relatively low distance to the electronic unit or the shielding device. Thereby, the antenna arrangement can be formed in installation space saving manner and be reliably operated at the same time.

In an embodiment, the first shielding element and the second shielding element are disposed to each other such that the signal deflected by the first shielding element is alternately reflected on the first shielding element and the second shielding element in a clearance between the first shielding element and the second shielding element. The second shielding element can be disposed to the first shielding element such that the signal reflected by the first shielding element subsequently impinges on the second shielding element. The signal is then reflected on the second shielding element and again impinges on the first shielding element. In other words, the signal is reflected back and forth between the first shielding element and the second shielding element. The first and the second shielding element can now allow propagation of the signal reflected by the first shielding element as it is for example known from a waveguide. Thereby, it can be achieved that the signal is guided past the first shielding element into the area. Thus, it can be achieved in effective manner that the signal enters the area, which otherwise would be shadowed by the first shielding element.

Furthermore, it is advantageous if the first shielding element and the second shielding element are disposed to each other such that the deflected signal propagates along the predetermined emitting direction and/or the predetermined receiving direction in reflection on the first shielding element and the second shielding element. As already explained, the signal deflected by the first shielding element can propagate in the clearance between the first shielding element and the second shielding element in the manner of a waveguide. Therein, the first shielding element and/or the second shielding element can be configured and/or disposed such that the reflected signal propagates substantially along the

predetermined emitting direction and/or receiving direction as a result of the total reflection on the first shielding element and the second shielding element. Thus, it can be achieved in simple manner that the reflected signal is guided past the shielded electronic unit. Herein, it is in particular provided that the first and/or the second shielding element are formed such that the reflected signal enters the otherwise shielded area after passing past the first shielding element or the shielded electronic unit.

Furthermore, it is advantageous if the first shielding element and/or the second shielding element are formed such that a main extension direction of the first shielding element and/or a main extension direction of the second shielding element substantially extend along the predetermined emitting direction and/or the predetermined receiving direction. The predetermined emitting direction and/or the predetermined receiving direction result based on the transmitting characteristic and receiving characteristic, respectively, of the antenna. If both the first shielding element and the second shielding element are disposed substantially along the emitting direction and/or the receiving direction, it can be achieved that the portion of the signal reflected on the first shielding element is passed into the area past the first shielding element. The portion of the signal, which is not reflected on the first shielding element, is influenced as little as possible in emitting direction and receiving direction, respectively, by the arrangement of the first and/or the second shielding element. In this manner, signals can be reliably emitted and/or received by means of the antenna if the shielded electronic unit is arranged in a low distance to the antenna.

In a further embodiment, the shielding device has a plurality of first shielding elements, which surround the electronic unit at least in certain areas. In particular, it is provided that the plurality of first shielding elements completely surround the electronic unit. The respective first shielding elements can for example be substantially plate-shaped formed. The first shielding elements can also have a predetermined curvature. The first shielding elements can be disposed to each other such that they constitute a housing for the electronic unit. If the antenna is for example formed such that the signal is substantially spherically emitted starting from the antenna, the first shielding elements can be disposed to each other such that they have the shape of a prism with a triangular base area. It can also be provided that the first shielding elements are disposed to each other such that they form a conical housing for the electronic unit. By this shaping, it can be achieved that the emitted signal and/or the signal to be received are influenced as little as possible.

In a further embodiment, the shielding device has a plurality of second shielding elements, which are each disposed parallel to the first shielding elements. By the substantially

parallel arrangement of the second shielding elements to at least some of the first shielding elements, as explained, an arrangement can be achieved, in which a portion of the signal reflected by the first shielding element is passed in the clearance between the first and the second shielding element in the manner of a waveguide. As already explained, the geometric configuration or the orientation of the first and/or the second shielding element can be selected such that the reflected signal is guided past the first shielding element into the area, which otherwise would be shadowed by the first shielding element.

Furthermore, it is advantageous if the first shielding element and/or the second shielding element are formed of a metal at least in certain areas. It can be provided that the first shielding element and/or the second shielding element are completely formed of a metal. Basically, it is also conceivable that the first and/or the second shielding element have a base body having a coating formed of a metal. This metal can be selected such that the signal, which is to be received by the antenna, is reflected on the surface of the first shielding element and the second shielding element. Such shielding elements can be simply and inexpensively produced.

Furthermore, it is advantageous if the antenna emits and/or receives a high-frequency signal as the signal. For example, the signal can have frequencies of several MHz. Basically, it can be provided that the dimensions and/or the arrangements of the first shielding element and the second shielding element are adapted to the frequency of the signal. In addition, the materials or the metal, of which the first shielding element and the second shielding element are formed at least in certain areas, can be adapted to the frequency of the signal. Thus, it can be achieved in reliable manner that the signal emitted by the antenna and/or the signal, which is to be received by the antenna, is passed into the area past the shielded electronic unit.

In a further configuration, the antenna arrangement has a camera and the electronic unit is a part of the camera. In other words, the camera is a part of the antenna arrangement. For example, an environmental region of the motor vehicle can be captured with the aid of the camera. Therein, the electronic unit can include the electronics of the camera. Thus, it becomes possible to arrange an antenna together with a camera in a low installation space.

Furthermore, it is advantageous if the antenna arrangement has an antenna housing, which can be disposed on an exterior trim part of the motor vehicle. The antenna

arrangement can for example be disposed on a roof of the motor vehicle. The antenna arrangement can be formed in the manner of a shark fin antenna. For example, the antenna housing can have a shape resembling that of a shark fin. Further, it can be provided that the antenna housing has an opening, through which a lens of the camera is passed at least in certain areas. Thus, a camera can be integrated in a shark fin antenna. For example, the area behind the motor vehicle can then be captured by the camera and be presented to the driver on a corresponding display device of the motor vehicle. In addition, the reliable operation of the antenna can be guaranteed by the configuration of the shielding device.

The motor vehicle according to the invention includes an antenna arrangement according to the invention. The motor vehicle is in particular formed as a passenger car.

The preferred embodiments presented with respect to the antenna arrangement according to the invention and the advantages thereof correspondingly apply to the motor vehicle according to the invention.

Further features of the invention are apparent from the claims, the figures and the description of figures. The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of figures and/or shown in the figures alone are usable not only in the respectively specified combination, but also in other combinations or alone, without departing from the scope of the invention. Thus, implementations are also to be considered as encompassed and disclosed by the invention, which are not explicitly shown in the figures and explained, but arise from and can be generated by separated feature combinations from the explained implementations. Implementations and feature combinations are also to be considered as disclosed, which thus do not have all of the features of an originally formulated independent claim.

Now, the invention is explained in more detail based on preferred embodiments as well as with reference to the attached drawings.

There show:

Fig. 1 a motor vehicle according to an embodiment of the present invention, which has an antenna arrangement;

Fig. 2 an antenna arrangement according to the prior art in a schematic illustration; and

Fig. 3 an antenna arrangement according to an embodiment of the present invention in a schematic illustration.

In the figures, identical and functionally identical elements are provided with the same reference characters.

Fig. 1 shows a motor vehicle 1 according to an embodiment of the present invention in a plan view. In the present case, the motor vehicle 1 is formed as a passenger car. The motor vehicle 1 includes an antenna arrangement 2 disposed on an exterior trim part 3 of the motor vehicle 1. In the present embodiment, the antenna arrangement 2 is disposed on a body sheet of the roof of the motor vehicle 1.

The antenna arrangement 2 includes an antenna housing 4, which has the shape of a shark fin. In the antenna housing 4, an antenna 5 is disposed, by means of which signals can be emitted and/or received. The antenna 5 can for example serve for receiving radio signals or signals of a satellite-assisted positioning system as the signal. Further, signals for the vehicle-to-vehicle communication or the vehicle-to-infrastructure communication can be emitted and/or received by the antenna 5. The antenna 5 can also include multiple individual antennas.

The antenna arrangement 2 further includes a camera 6, by means of which for example an environmental region behind the motor vehicle 1 can be captured. Images or video data can be provided by the camera 6, which can then be presented to the driver on a corresponding display device. Basically, it can also be provided that the motor vehicle 1 includes further cameras, by which for example the environmental region next to the motor vehicle 1 and/or in front of the motor vehicle 1 can be captured. The camera 6 includes a lens 7, which presently is disposed outside of the antenna housing 4 in certain areas. Moreover, the camera 6 includes an electronic unit 8, which constitutes the electronics of the camera 6. The electronic unit 8 can for example include the image sensor of the camera 6.

Fig. 2 shows an antenna arrangement 2 according to the prior art in a severely simplified illustration. In the present example, the antenna 5 emits a signal. This signal propagates

substantially spherically. Presently, this is illustrated by the lines 9. Presently, the electronic unit 8 is disposed in a relatively low distance to the antenna 5. The electronic unit 8 usually has a plurality of electronic components not illustrated here, which cause electromagnetic interferences in the operation. In order to prevent influence of further electrical components by these electromagnetic interferences, a shielding device 10 is provided, by means of which the electronic unit 8 is electromagnetically shielded. The shielding device 10 presently includes multiple first shielding elements 11. These first shielding elements 11 are substantially plate-shaped formed and disposed to each other such that they form substantially a prismatic housing for the electronic unit 8. The first shielding elements 11 can for example be formed of a corresponding metal. By the first shielding elements 11, at least a part of the emitted signal is shielded or reflected. For the emitted signal, thus, an area 13 arises, which is shadowed by the first shielding elements 11. In case that a signal is to be received by the antenna 5, a further area 13' arises by the arrangement of the shielded electronic unit 8, which is shadowed by the first shielding elements 11 for the signal to be received. Thereby, reliable operation of the antenna 5 can still be ensured.

Fig. 3 shows an antenna arrangement 2 according to an embodiment of the present invention in a severely simplified illustration. Here too, the shielding device 10 has first shielding elements 11. Therein, at least some of the first shielding elements 11 are disposed substantially along a predetermined transmitting direction 14. This predetermined transmitting direction 14 results from the emitting characteristic of the antenna 5. Presently, the predetermined transmitting direction 14 extends radially outwards starting from the antenna 5. Similarly, the first shielding elements 11 can be disposed along a predetermined receiving direction 15. This predetermined receiving direction 15 arises based on the receiving characteristic of the antenna 5. Presently, two of the first shielding elements 11 are disposed along the predetermined transmitting direction 14. Presently, the first shielding elements 11 are disposed to each other such that they form a prismatic housing with a triangular base area.

Moreover, the shielding device 10 includes second shielding elements 12. Presently, the second shielding elements 12 are also disposed along the predetermined transmitting direction 14. The two second shielding elements 12 are disposed substantially parallel to the two first shielding elements 11, which extend along the predetermined transmitting direction 14. The second shielding elements 12 can also be formed of a metal and serve for reflecting the signal emitted by the antenna 5 or the signal received by the antenna 5.

A clearance 17 is formed between the respective first shielding elements 11 and the second shielding elements 12.

A part of the signal emitted by the antenna 5 is reflected by the first shielding element 11. This reflected signal 16 subsequently impinges on the second shielding element 12 and is again reflected by it. Thus, an arrangement is achieved, which is known from a waveguide, in which the reflected signal 16 is reflected back and forth in the clearance 17 between the respective first shielding element 11 and the respective second shielding element 12. Thus, the reflected signal 16 can be guided past the first shielding element 11. The respective first shielding elements 11 and the respective second shielding elements 12 are formed such that the reflected signal 16 is guided into the area 13, which otherwise would be shadowed by the first shielding elements 11. Thereby, it can be achieved that the signal emitted by the antenna 5 also enters the area 13.

If a signal is to be received by the antenna 5, it can also be guided through the clearance between the first shielding element 11 and the second shielding element 12. Thereby, it can be achieved that the signal to be received enters the area 13', which otherwise is shielded by the first shielding elements 11. Thus, reliable operation of the antenna 5 can be allowed even if the electronic unit 8 of the camera 6 is disposed relatively close to the antenna 5. Thus, it can overall be achieved that the camera 6 together with its electronic unit 8 can be operated within the antenna arrangement 2.

Claims

1. Antenna arrangement (2) for a motor vehicle (1), including an antenna (5) for emitting and/or receiving a signal, including an electronic unit (8) and including a shielding device (10) for electromagnetically shielding the electronic unit (8), wherein the shielding device (10) has a first shielding element (11), which deflects the emitted signal from a predetermined emitting direction (14) and/or deflects the signal to be received from a predetermined receiving direction (15),
characterized in that
the shielding device (10) has a second shielding element (12), which is adapted to deflect the signal (16) deflected by the first shielding element (11) into an area (13, 13'), which is shadowed for the emitted signal and/or the signal to be received by the first shielding element (11).

2. Antenna arrangement (2) according to claim 1,
characterized in that
the first shielding element (11) and the second shielding element (12) are disposed to each other such that the signal (16) deflected by the first shielding element (11) is alternately reflected on the first shielding element (11) and the second shielding element (12) in a clearance (17) between the first shielding element (11) and the second shielding element (12).

3. Antenna arrangement (2) according to claim 2,
characterized in that
the first shielding element (11) and the second shielding element (12) are disposed to each other such that the deflected signal (16) propagates along the predetermined emitting direction (14) and/or the predetermined receiving direction (15) in reflection on the first shielding element (11) and the second shielding element (12).

4. Antenna arrangement (2) according to any one of the preceding claims,
characterized in that
the first shielding element (11) and/or the second shielding element (12) are formed such that a main extension direction of the first shielding element (11) and/or a main

extension direction of the second shielding element (12) substantially extend along the predetermined emitting direction (14) and/or the predetermined receiving direction (15).

5. Antenna arrangement (2) according to any one of the preceding claims, characterized in that
the shielding device (10) has a plurality of first shielding elements (11), which surround the electronic unit (8) at least in certain areas.

6. Antenna arrangement according to claim 5,
characterized in that
the shielding device (10) has a plurality of second shielding elements (12), which are each disposed parallel to the first shielding elements (11).

7. Antenna arrangement (2) according to any one of the preceding claims, characterized in that
the first shielding element (11) and/or the second shielding element (12) are formed of a metal at least in certain areas.

8. Antenna arrangement (2) according to any one of the preceding claims, characterized in that
the antenna (5) emits and/or receives a high-frequency signal as the signal.

9. Antenna arrangement (2) according to any one of the preceding claims, characterized in that
the antenna arrangement (2) has a camera (6) and the electronic unit (8) is a part of the camera (6).

10. Antenna arrangement (2) according to any one of the preceding claims, characterized in that
the antenna arrangement (2) has an antenna housing (4), which can be disposed on an exterior trim part (3) of the motor vehicle (1).

11. Motor vehicle (1) with an antenna arrangement (2) according to any one of the preceding claims.

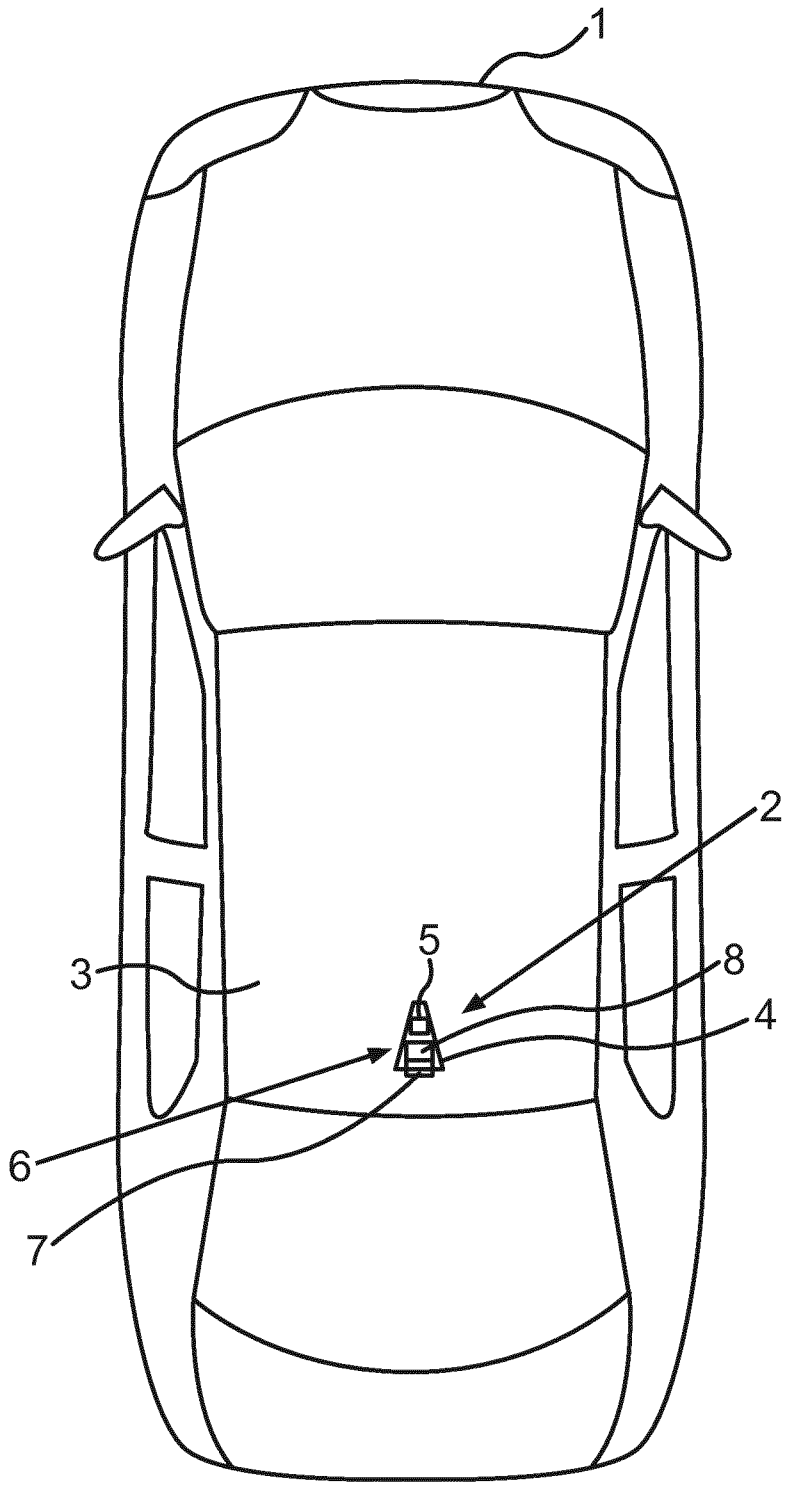

Fig.1

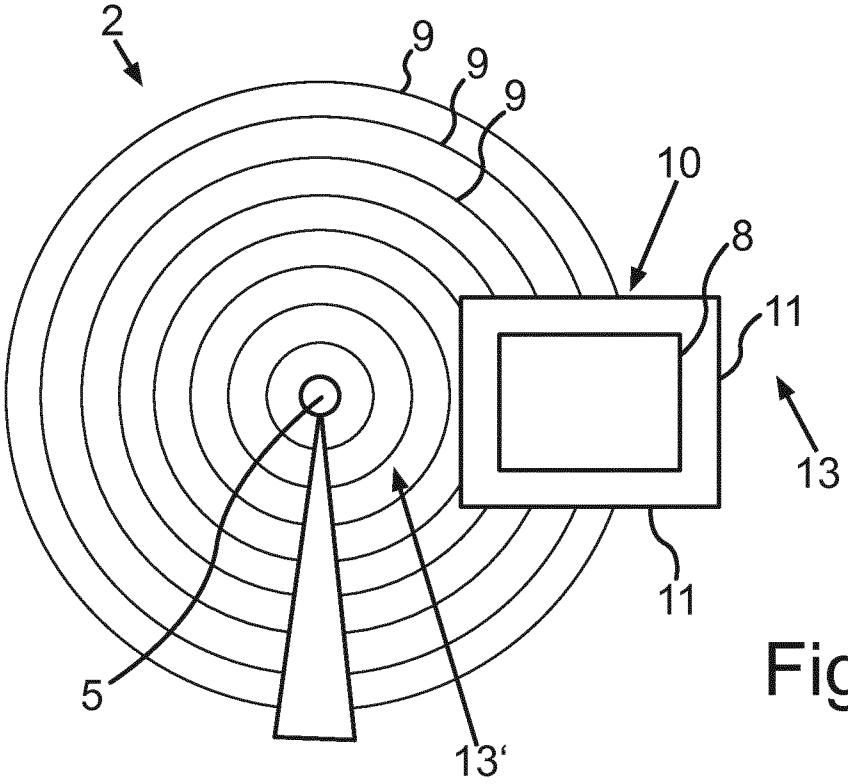

Fig.2

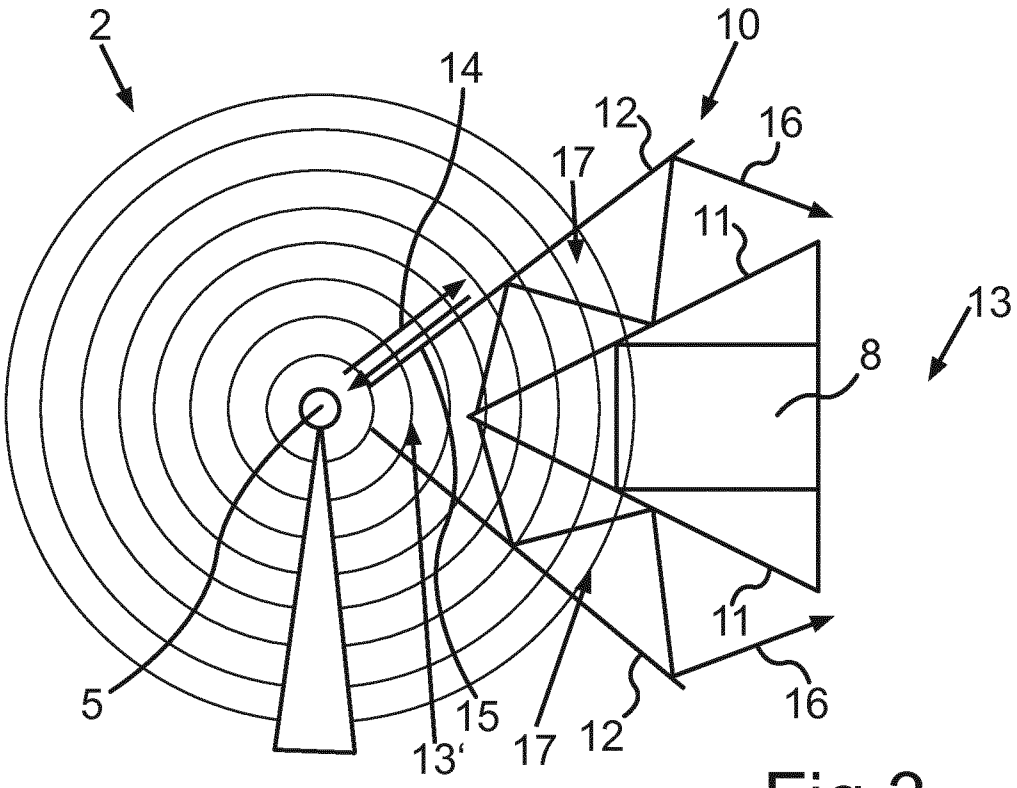

Fig.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/079387

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01Q1/32 H01Q1/52 H01Q15/18
ADD.

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)
H01Q

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 2012/274519 A1 (CHAKAM GUY-AYMAR [DE] ET AL) 1 November 2012 (2012-11-01) paragraph [0041] - paragraph [0053]; figures 1-4	1,4-7, 9-11 8 2,3
Y A	DE 10 2009 012615 A1 (GM GLOBAL TECH OPERATIONS INC [US]) 16 September 2010 (2010-09-16) paragraph [0021]; figure 1	8 1
A	US 2013/120210 A1 (ZEIGER DAVID [US] ET AL) 16 May 2013 (2013-05-16) paragraph [0016] - paragraph [0028]; figures 1,2	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 February 2017	16/02/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Degraeve, Alexis

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/079387

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012274519 A1	01-11-2012	CN 102714349 A	03-10-2012
		DE 102009051605 A1	05-05-2011
		EP 2497148 A1	12-09-2012
		US 2012274519 A1	01-11-2012
		WO 2011051454 A1	05-05-2011
DE 102009012615 A1	16-09-2010	NONE	
US 2013120210 A1	16-05-2013	CN 103918126 A	09-07-2014
		DE 112012004736 T5	31-07-2014
		US 2013120210 A1	16-05-2013
		WO 2013074214 A1	23-05-2013