



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.04.2019 Bulletin 2019/14

(51) Int Cl.:
H01Q 1/12 (2006.01)

(21) Application number: **17194355.8**

(22) Date of filing: **02.10.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(72) Inventor: **Laurens, Marcel**
3076 XE Rotterdam (NL)

(74) Representative: **Wuyts, Koenraad Maria**
Koninklijke KPN N.V.
Intellectual Property Group
P.O. Box 25110
3001 HC Rotterdam (NL)

(71) Applicant: **Koninklijke KPN N.V.**
3072 AP Rotterdam (NL)

(54) **SYSTEM FOR SUSPENDING AN ANTENNA TO A MAST, MAST PROVIDED WITH AN ANTENNA AND METHOD FOR SUSPENDING AN ANTENNA TO A MAST**

(57) A system is provided for suspending an antenna to a mast comprising a suspending device for suspending said antenna to said mast at a first location of said mast, wherein said suspending device comprises a first suspending element that is arranged for attachment to said mast at said first location of said mast and a second suspending element that is arranged for attachment to said antenna at a first location of said antenna. Further, a mast is provided with an antenna, wherein said antenna is suspended to said mast using the system. Also a method is provided for suspending an antenna to a mast using the system.

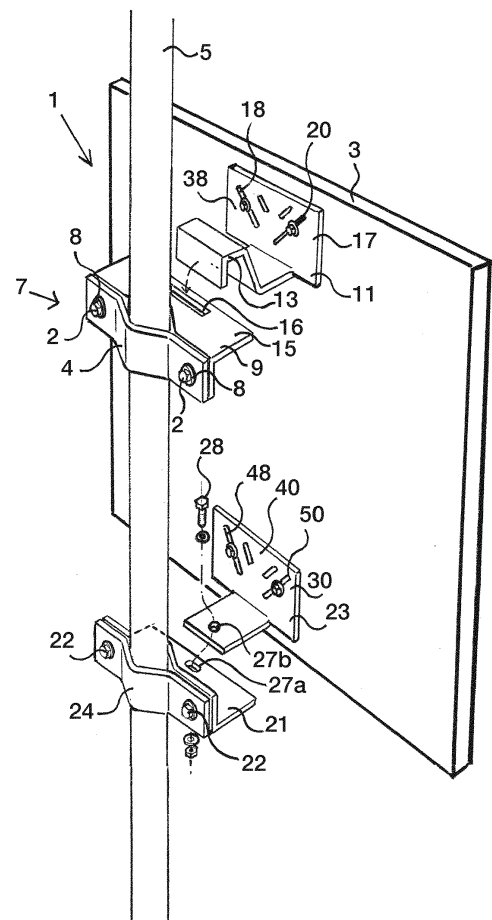


Figure 1

Description

FIELD OF THE INVENTION

[0001] According to a first aspect the present disclosure relates to a system for suspending an antenna to a mast.

[0002] According to a second aspect the present disclosure relates to a mast provided with an antenna, wherein said antenna is suspended to said mast using a system according to the first aspect of the present disclosure.

[0003] According to a third aspect the present disclosure relates to a method for suspending an antenna to a mast using a system according to the first aspect.

BACKGROUND

[0004] A known system for suspending an antenna to a mast comprises multiple brackets which are interconnected via fastening organs such as nuts and bolts.

SUMMARY

[0005] A drawback of this system is that obtaining a desired suspension of the antenna to the mast is rather cumbersome. Suspending antennas to a mast usually requires the use of a crane or lifting equipment, which is relatively expensive.

[0006] An objective of the present disclosure is to provide a system for realising a suspension of an antenna to a mast that is improved as regards the required effort for realising a desired suspension of the antenna to the mast.

[0007] This objective is achieved in that the system according to the present disclosure comprises a suspending device for suspending said antenna to said mast at a first location of said mast, wherein said suspending device comprises a first suspending element that is arranged for attachment to said mast at said first location of said mast and a second suspending element that is arranged for attachment to said antenna at a first location of said antenna, wherein said first location of said antenna, in use, is above the centre of gravity of said antenna, wherein one of said first suspending element and said second suspending element comprises a protrusion and the other one of said first suspending element and said second suspending element comprises a receiving member for at least partly receiving said protrusion by said other one of said first suspending element and said second suspending element for suspending said antenna to said mast at said first location of said mast. Since the system according to the present disclosure is provided with a receiving member for at least partly receiving said protrusion for suspending said antenna to said mast the need for interconnection of multiple brackets is no longer required. Instead the first suspending element can be attached to said mast and said second suspending ele-

ment can be attached to said antenna before actually raising said antenna to said first position of said mast for realising said suspension by at least partly receiving said protrusion by said receiving member thereby reducing the effort for realising a desired suspension of the antenna to said mast.

[0008] An additional advantage of the system according to the first aspect of the present disclosure is an improvement of the safety for the workers suspending an antenna to a mast. Once said antenna is suspended the risk of said antenna falling downwards is greatly reduced, whereas for the known system said antenna needs to be secured by hand or lifting equipment until the multiple brackets are interconnected via fastening organs. As such, the complexity of the activities of the workers for suspending said antenna at said first position of said antenna is reduced thereby reducing the safety risks for the workers.

[0009] A further additional advantage of the system according to the first aspect of the present disclosure is a reduction of damage to antennas occurring due to attaching said antenna to a mast. In particular damage due to falling of said antenna is reduced since there is less need for the workers to perform complex activities at said first position of said mast involving holding said antenna.

[0010] Within the context of the present disclosure a mast is a substantially vertical structure placed on a substrate, such as a ground or a building. Preferably said mast is a vertical structure extending in a longitudinal direction, wherein said longitudinal direction is perpendicular to said substrate. Such masts are known and are generally made of a metal such as galvanised steel, wherein the known masts generally have a round outer shape. However, the shape of the mast is not limiting to this invention and any type of antenna mast as known in the art may be used and comprises masts having a rectangular outer surface. The main body of the mast may for example form a single pole. In one alternative example, the main body of the mast may comprise metal bars of circular or angular shape. The shape of the mast may be tapered towards the top around a vertical axis, with the surface being defined by bars that are only substantially vertical due to the tapered form. Also, the mast may comprise round vertical bars for attaching antennas or may comprise any other suitable construction for attaching antennas which may include angular shapes, in particular angular metal profiles.

[0011] It is beneficial if said receiving member comprises an opening for at least partly receiving said protrusion for suspending said antenna to said mast at said first location of said mast. An opening in said receiving member is beneficial for allowing said protrusion to extend, in use, through said receiving member for realising a relatively reliable suspension of said second suspending element to said first suspending element.

[0012] Preferably, said opening of said receiving member has a shape corresponding to a cross-section of said protrusion such that a wall (or edge) surrounding said

opening upon receiving said protrusion bears against said protrusion for realizing an improved stability of said suspension. The opening of the receiving member of the suspending element and the corresponding protrusion do not have to be of rectangular shape. Any shape may be suitable, in particular angular shapes that fix the antenna in a direction facing away from the mast. In another embodiment, the opening of the receiving member of the suspending element may be of round shape, and the protrusion may be of corresponding round shape. An advantage of this embodiment is that the antenna may be adjusted around a vertical axis after it is suspended.

[0013] In a particular attractive embodiment of the system according to the first aspect said protrusion and said opening are configured as a mortise-and-tenon joint for realizing a relative robust and stable suspension. In an embodiment of the system according to the first aspect said protrusion has a rectangular cross-sectional shape and said opening of said receiving member has a corresponding rectangular shape, wherein said opening preferably is 8 cm long and 1 cm wide.

[0014] In an embodiment of the system according to the first aspect said protrusion is hook shaped for hooking said protrusion to said receiving member. A hook shaped protrusion is attractive for realising a hooking action upon interconnecting said first and second suspending element thereby reducing the risk of an undesired disconnection of said first and second suspending element.

[0015] Preferably, said second suspending element comprises an attachment organ for attaching said second suspending element to said antenna, wherein a wall of said attachment organ may comprise a first opening and a second opening, wherein said first opening and said second opening are each arranged for receiving a fastening organ for fastening said second suspending element to said antenna. Preferably said first opening and said second opening are elongated openings. Preferably, said first opening and said second opening are diverging away from each other along a surface of said wall. It is known that antennas from various manufacturers have different interfaces as regards attachment to structures such as a mast. By providing said first and second elongated opening in a diverging way a second suspending element is provided for attachment of said second suspending element to a variety of antennas. In this way a rather universal system is provided thereby avoiding, or at least reducing, the need for various designs of the system according to the first aspect.

[0016] In a very robust embodiment of the system according to the first aspect, said system comprises a mounting device for mounting said antenna to said mast at a second location of said mast, wherein said mounting device comprises a first mounting element that is arranged for attachment to said mast at said second location and a second mounting element that is arranged for attachment to said antenna at a second location of said antenna, wherein said second location of said antenna, in use, is below said first location of said antenna, wherein

said first mounting element and said second mounting element are arranged for being fastened together. By providing such a mounting device said antenna is attachable to said mast at two different positions of said mast and two different positions of said antenna thereby providing for a relatively robust and reliable suspension of said antenna to said mast. In addition, it allows for an increased accuracy of positioning said antenna with respect to said mast.

[0017] In this regard it is beneficial if said first mounting element and said second mounting element are each provided with a through hole for receiving a further fastening organ for fastening said first mounting element together with said second mounting element. This is beneficial for allowing for a relative practical attachment of said first mounting element to said second mounting element via said further fastening organ. In particular in case, in use, said antenna is already suspended via said suspending device to said mast, there is no longer a need for holding the antenna in a substantially vertical position, thereby allowing for a relative easy fastening of said first mounting element together with said second mounting element.

[0018] In a practical embodiment of the system according to the first aspect, said second mounting element comprises a further attachment organ for attaching said second mounting element to said antenna, wherein a further wall of said further attachment organ comprises a further first elongated opening and a further second elongated opening, wherein said further first elongated opening and said further second elongated opening are each arranged for receiving a yet further fastening organ for fastening said second mounting element to said antenna, wherein said further first elongated opening and said further second elongated opening along a surface of said further wall are diverging away from each other.

[0019] A relative stable and robust suspension is achievable if said first suspending element and/or said first mounting element are provided with a recess for at least partly receiving said mast. It is particularly beneficial if said recess corresponds to a cross-sectional shape of said mast perpendicular to a longitudinal direction of said mast.

[0020] In a very attractive embodiment of the system according to the first aspect said first suspending element and said second suspending element are arranged for suspending said second suspending element to said first suspending element solely by receiving said protrusion at least partly by said receiving member. Realising a suspension at said first location of said mast of said antenna solely by receiving said protrusion by said receiving member is very attractive for reducing the complexity of the actions workers need to perform at said position of said mast thereby reducing the effort required to suspend said antenna to said mast.

[0021] In a yet further attractive embodiment of the system according to the first aspect said first suspending element and said second suspending element are solely

connectable by receiving said protrusion at least partly by said receiving member. This yet further attractive embodiment is particularly attractive for reducing the amount of actions need to perform at said first position of said mast.

[0022] Preferably said protrusion and said receiving member are arranged for realising, in use, an interlocking connection between said first suspending element and said second suspending element under the influence of gravity. Such a connection results in a relative reliable suspension of said antenna to said mast without the need for further fastening organs for maintaining a durable suspension.

[0023] Other options, such as combinations of elements of embodiments are possible. For example, in an embodiment of the system according to the first aspect, said first suspending element and said second suspending element are each provided with a further through hole for receiving a yet further fastening organ for fastening said first suspending element together with said second suspending element. This may provide a durable way of fastening the suspending element, for example when the antenna is to be durably mounted to the mast only by the suspending element.

[0024] In another option, it is not precluded that a second suspending device is used in the system instead of, in addition to, or combined with the mounting device. This may provide an easy way to suspend the antenna to the mast at at least two locations. Fastening means may be provided to the first and/or the second suspending device for fastening the respective suspending elements together.

[0025] According to the second aspect the present disclosure relates to a mast provided with an antenna, wherein said antenna is suspended to said mast using a system according to the first aspect of the present disclosure. The advantages of the mast provided with an antenna are analogous to the advantages of the system according to the first aspect of the present disclosure.

[0026] In an embodiment of said mast provided with said antenna, wherein said system is provided with said mounting device, the centre of gravity of said antenna is located at a height between the first and second location. In this regard, it is beneficial if the centre of gravity of said antenna is located at a height corresponding to an average height of the first and second location.

[0027] According to the third aspect, the present disclosure relates to a method for suspending an antenna to a mast using a system according to the first aspect of the present disclosure, said method comprising the steps of:

- attaching said first suspending element to said mast at said first location of said mast;
- attaching said second suspending element to said antenna at said first location of said antenna;
- receiving said protrusion at least partly by said receiving member for suspending said antenna to said

mast at said first location of said mast.

The advantages of the method are analogue to the advantages of the system according to the first aspect of the present disclosure.

[0028] In a practical embodiment of the method said steps of attaching are performed before said step of receiving. This embodiment is very practical since it avoids the need for holding said antenna to said first position of said mast while attaching said first suspending element to said first location of said mast and attaching said second suspending element to said antenna thereby reducing the amount of actions workers need to perform at or near said first position of said mast.

[0029] Preferably the method according to the third aspect for suspending the antenna to said mast using a system according to the first aspect of the present disclosure, wherein said system comprises a mounting device for mounting said antenna to said mast at a second location of said mast, wherein said mounting device comprises a first mounting element that is arranged for attachment to said mast at said second location and a second mounting element that is arranged for attachment to said antenna at a second location of said antenna, wherein said second location of said antenna, in use, is below said first location of said antenna, wherein said first mounting element and said second mounting element are arranged for being fastened together, further comprises the steps of:

- attaching said first mounting element to said mast at said second location of said mast;
- attaching said second mounting element to said antenna at said second location of said antenna;
- fastening said first mounting element and said second mounting element together using a fastening member.

[0030] In this regard, it is beneficial if said first location of said mast is located above said second location of said mast. This is beneficial for realising a relative robust and reliable suspension of said antenna to said mast.

[0031] In a practical embodiment of the method according to the third aspect, the step of receiving is performed before said step of fastening. This is a practical method for avoiding the need to maintain the antenna in a raised position while fastening said first mounting element together with said second mounting element.

[0032] The present disclosure will now be explained by means of a description of preferred embodiments of a system according to the disclosure and of masts provided with an antenna, wherein said antenna is suspended to said mast using a system according to the first aspect of the present disclosure, in which reference is made to the following schematic figures, in which:

Figure 1: in isometric exploded view, a system according to the first aspect of the present disclosure,

a mast and an antenna are shown;

Figure 2: in cross-section the system from Figure 1 attached to a mast and an antenna is shown;

Figure 3: a detail of the cross-section shown in Figure 2 is shown;

Figure 4: in isometric view a mast and a system according to the first aspect of the present disclosure is shown;

Figure 5: in cross-section the system from Figure 4 attached to a mast and an antenna is shown;

Figure 6: a detail of the cross-section shown in Figure 5 is shown;

Figure 7: a detail of the cross-section shown in Figure 5 is shown;

Figure 8: in isometric exploded view a system according to the first aspect of the present disclosure and a mast are shown.

[0033] System 1, shown in Figures 1 - 3, suspends an antenna 3 to a mast 5. The mast 5 is made from metal, has a round outer shape and extends in a longitudinal direction L. A first suspending element 9 of a suspending device 7 is attached to said mast 5 via bolts 2 and a first clamping element 4, wherein said first clamping element 4 is located at a side opposite to said first suspending element 9 of said mast 5. Said bolts 2 are received in bolt holes 8 of said first suspending element 9 and tightened such that said first clamping element 4 and said first suspending element 9 are fixated to said mast 5 at a first location of said mast by a clamping force. Alternatively it is conceivable that said first suspending element is attached to said mast using welding or by providing said mast with threaded holes.

[0034] A second suspending element 11 of said suspending device 7 is attached to said antenna 3 via an attachment organ 17. The attachment organ 17 is provided with a wall 38 comprising a first elongated opening 18 and a second elongated opening 20. The first elongated opening 18 and the second elongated opening 20 are each arranged for receiving a fastening organ for fastening said second suspending element 11 to the antenna 3. The first elongated opening 18 and the second elongated opening 20 diverge away from each other along a surface 26 of said wall 38. The second suspending element 11 has a substantially S-shaped cross-section in side view and is manufactured from 8 mm thick metal sheet. The second suspending element 11 is provided with a hook shaped protrusion 13 that is hooked into opening 16 of a receiving member 15 of the first suspending element 9. As a result the second suspending element 11 is allowed to rest on the first suspending element 9 and thereby realising an interlocking connection between said first suspending element 9 and said second suspending element 11 under the influence of gravity.

[0035] At a second location of said mast 5, a mounting device 19 of said system 1 is attached to said mast 5. Said second location of said mast 5 is located below said

first location. Preferable the distance between the first location and the second location of said mast is in the range of 0,5 - 1.5 m, wherein the centre of gravity of said antenna 3 is preferably located at a height between the first and second location. The mounting device 19 comprises a first mounting element 21 which is attached to said mast 5 via further bolts 22 and a second clamping element 24. Said second clamping element 24 is located at a side opposite of said first mounting element 21 of said mast 5. The further bolts 22 are received in further bolt holes 10 of said first mounting element 21 and are tightened such that said second clamping element 24 and the first mounting element 21 are fixated to said mast 5 at said second location of said mast 5 by a further clamping force. Alternatively it is conceivable that said first mounting element is attached to said mast using welding or by providing said mast with threaded holes.

[0036] The mounting device 19 further comprises a second mounting element 23 that is attached to said antenna 3 at a second location, wherein said second location is different from said first location of said antenna. The second mounting element 23 comprises a further attachment organ 30 that is similar to the attachment organ 17. The further attachment organ 30 comprises a further wall 40 for attaching said second mounting 23 element to said antenna 3. The further wall 40 of said further attachment organ 30 comprises a further first elongated opening 48 and a further second elongated opening 50. The further first elongated opening 48 and the further second elongated opening 50 are each arranged for receiving a yet further fastening organ for fastening said second mounting element 23 to said antenna 3, wherein said further first elongated opening 48 and said further second elongated opening 50 are diverging away from each other along a surface 42 of said further wall 40.

[0037] Both the first mounting element 21 and the second mounting element 23 are provided with a through hole 27a, 27b for receiving a fastening bolt 28 for fastening said first mounting element 21 together with said second mounting element 23. It is conceivable that said clamping force and said further clamping force are different to achieve a different level of fixation to said mast at said first location and said second location. In particular when said antenna 3 is fully suspended by said suspending device 7 a stronger fixation, at least before and during mounting of said antenna 3 to said mast 5, than a fixation at said second position can be beneficial to realise a relative practical fastening of said first mounting element 21 to said second mounting element 23.

[0038] System 101 shown in Figure 4 - 7 differs from system 1 in that the second suspending element 111 is provided with said receiving member 115 and the first suspending element 109 is provided with said protrusion 113. Elements of system 101 that are similar to elements of system 1 are provided with a reference number equal to the reference number of the element in system 1 raised by 100.

[0039] System 201 shown in Figure 8 differs from system 1 in that the second suspending element 211 has a different cross-sectional shape. The cross-sectional shape of the second suspending element 211 is attractive for realising a suspending device 207 that is easier or at least cheaper to produce. Elements of system 201 that are similar to elements of system 1 are provided with a reference number equal to the reference number of the element in system 1 raised by 200.

Claims

1. System (1, 101) for suspending an antenna (3) to a mast (5), said system (1) comprising a suspending device (7, 107) for suspending said antenna (3) to said mast (5) at a first location of said mast (5), wherein said suspending device (7, 107) comprises a first suspending element (9, 109) that is arranged for attachment to said mast (5) at said first location of said mast (5) and a second suspending element (11, 111) that is arranged for attachment to said antenna (3) at a first location of said antenna (3), wherein said first location of said antenna (3), in use, is above the centre of gravity of said antenna (3), wherein one of said first suspending element (9) and said second suspending element (11, 111) comprises a protrusion (13, 113) and the other one of said first suspending element (9, 109, 209) and said second suspending element (11, 111) comprises a receiving member (15, 115) for at least partly receiving said protrusion (13, 113) by said other one of said first suspending element (9) and said second suspending element (11, 111) for suspending said antenna (3) to said mast (5) at said first location of said mast (5).
2. System (1, 101) according to claim 1, wherein said receiving member (15, 115) comprises an opening (16, 116) for at least partly receiving said protrusion (13, 113) for suspending said antenna (3) to said mast (5) at said first location of said mast (5).
3. System (1, 101, 201) according to claim 1 or 2, wherein said protrusion (13, 113) is hook shaped for hooking said protrusion (13, 113) to said receiving member (15, 115).
4. System (1) according to any one of the preceding claims, wherein said second suspending element (11) comprises an attachment organ (17) for attaching said second suspending element (11) to said antenna (3), wherein a wall (22) of said attachment organ (217) comprises a first elongated opening (18) and a second elongated opening (20), wherein said first elongated opening (18) and said second elongated opening (20) are each arranged for receiving a fastening organ for fastening said second suspending element (11) to said antenna (3), wherein said first opening (18) and said second opening (20) along a surface (24) of said wall (22) are diverging away from each other.
5. System (1, 101) according to any one of the preceding claims, wherein said system (1, 101) comprises a mounting device (19, 119) for mounting said antenna (3) to said mast (5) at a second location of said mast (5), wherein said mounting device (19, 119) comprises a first mounting element (21, 121) that is arranged for attachment to said mast (5) at said second location and a second mounting element (23, 123) that is arranged for attachment to said antenna (3) at a second location of said antenna (3), wherein said second location of said antenna (3), in use, is below said first location of said antenna (3), wherein said first mounting element (21, 121) and said second mounting element (23, 123) are arranged for being fastened together.
6. System (1, 101) according to claim 5, wherein said first mounting element (21, 121) and said second mounting element (23, 123) are each provided with a through hole (27a, 27b, 127a, 127b) for receiving a further fastening organ for fastening said first mounting element (21, 121) together with said second mounting element (23, 123).
7. System (1) according to any one of the preceding claims, wherein said first suspending element (9) and/or said first mounting element (11) are provided with a recess (25) for at least partly receiving said mast (5).
8. System (1, 101) according to any one of the preceding claims, wherein said first suspending element (9, 109) and said second suspending element (11, 111) are arranged for suspending said second suspending element (11, 111) to said first suspending element (9, 109) solely by receiving said protrusion (13, 113) at least partly by said receiving member (15, 115).
9. System (1, 101) according to any one of the preceding claims, wherein said first suspending element (9, 109) and said second suspending element (11, 111) are solely connectable by receiving said protrusion (13, 113) at least partly by said receiving member (15, 115).
10. System (1, 101) according to any one of the preceding claims, wherein said protrusion (13, 113) and said receiving member (15, 115) are arranged for realising, in use, an interlocking connection between said first suspending element (9, 109) and said second suspending element (11, 111) under the influence of gravity.

11. Mast (5) provided with an antenna (3), wherein said antenna (3) is suspended to said mast (5) using a system (1, 101) according to any one of the preceding claims. 5
12. Method for suspending an antenna (3) to a mast (5) using a system according to any one of the claims 1 - 10, said method comprising the steps of:
- attaching said first suspending element (9, 109) to said mast (5) at said first location of said mast (5); 10
 - attaching said second suspending element (11, 111) to said antenna (3) at said first location of said antenna (3); 15
 - receiving said protrusion (13, 113) at least partly by said receiving member (15, 115) for suspending said antenna (3) to said mast (5) at said first location of said mast (5). 20
13. Method according to claim 12, wherein said steps of attaching are performed before said step of receiving. 25
14. Method according to claim 12 or 13 using a system (1, 101) according to claim 5 or a claim dependent thereof, said method further comprising the steps of:
- attaching said first mounting element (21, 121) to said mast (5) at said second location of said mast (5); 30
 - attaching said second mounting element (23, 123) to said antenna (3) at said second location of said antenna (3);
 - fastening said first mounting element (21, 121) and said second mounting element (23, 123) together using a fastening member. 35
15. Method according to claim 14, wherein said first location of said mast (5) is located above said second location of said mast (5). 40

45

50

55

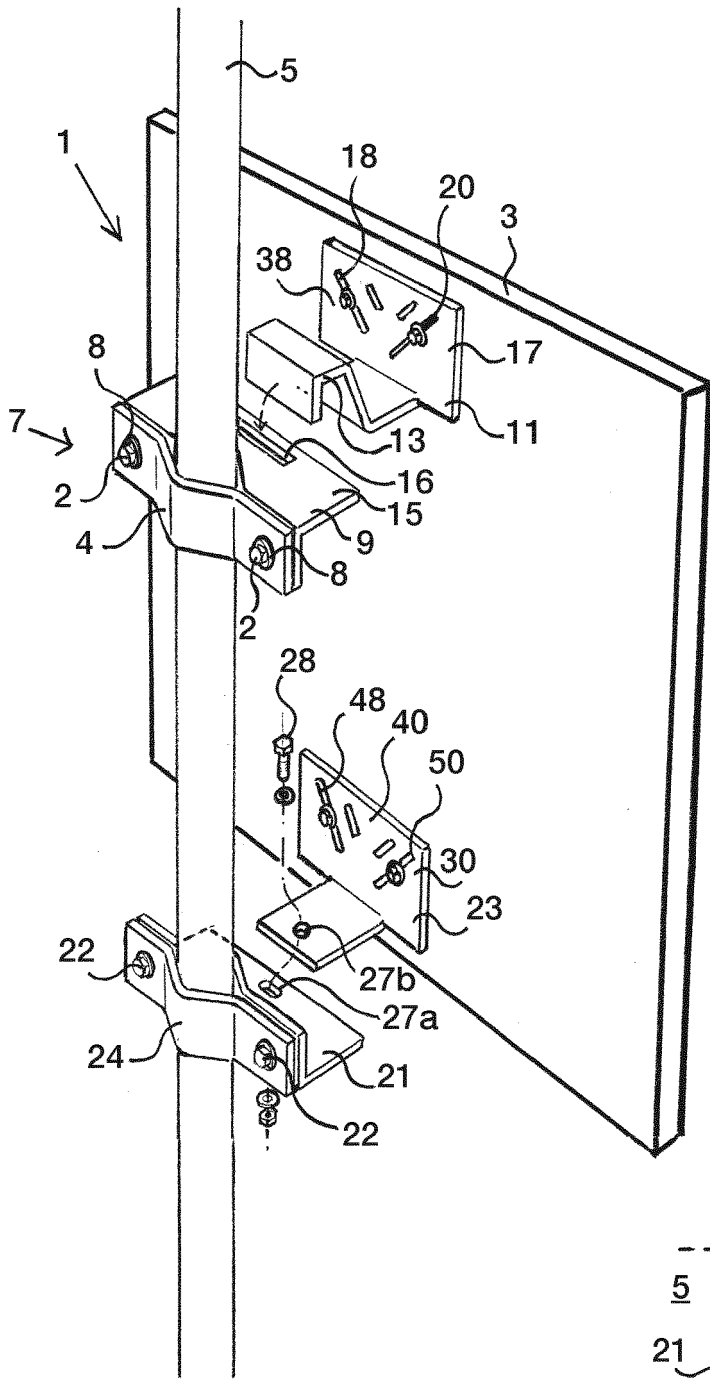


Figure 1

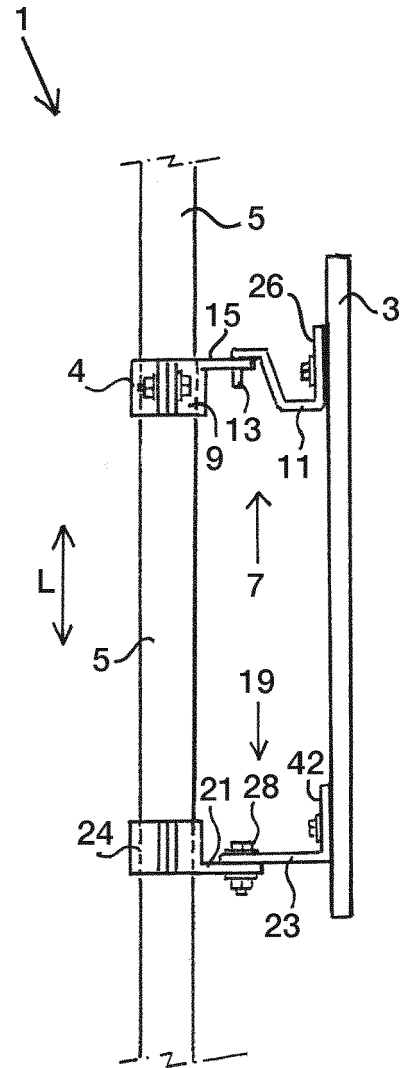


Figure 2

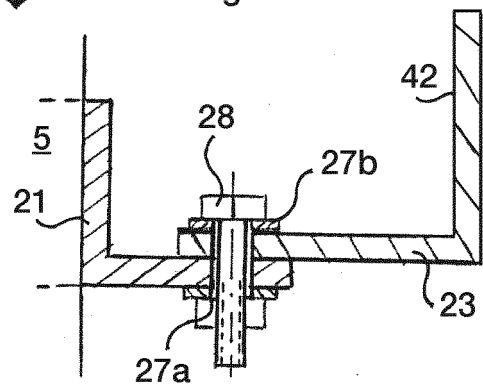
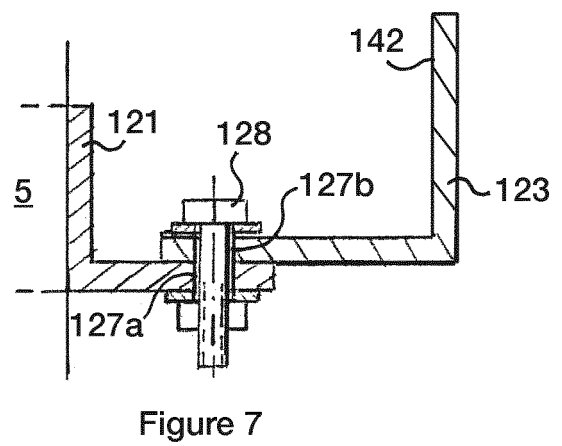
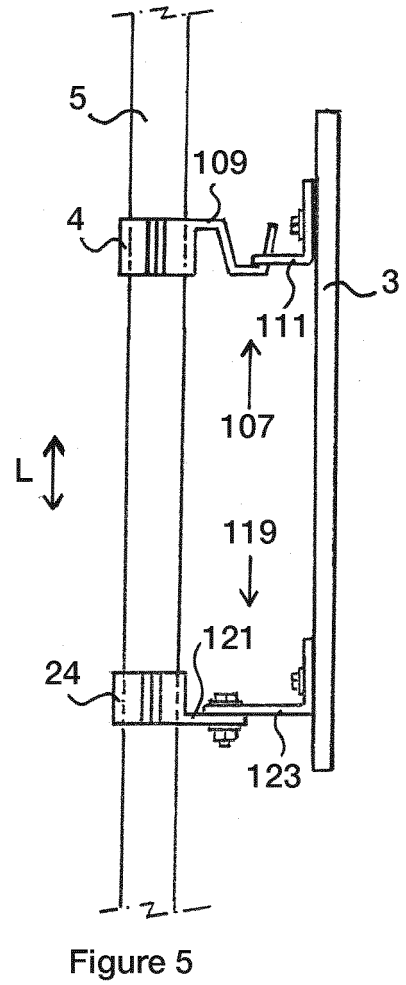
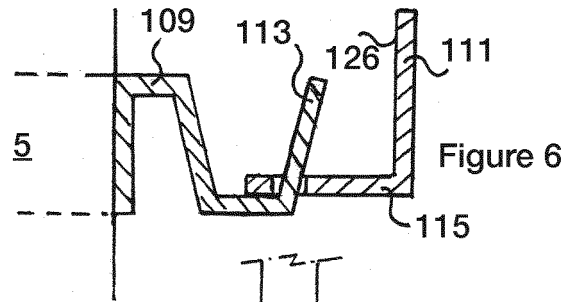
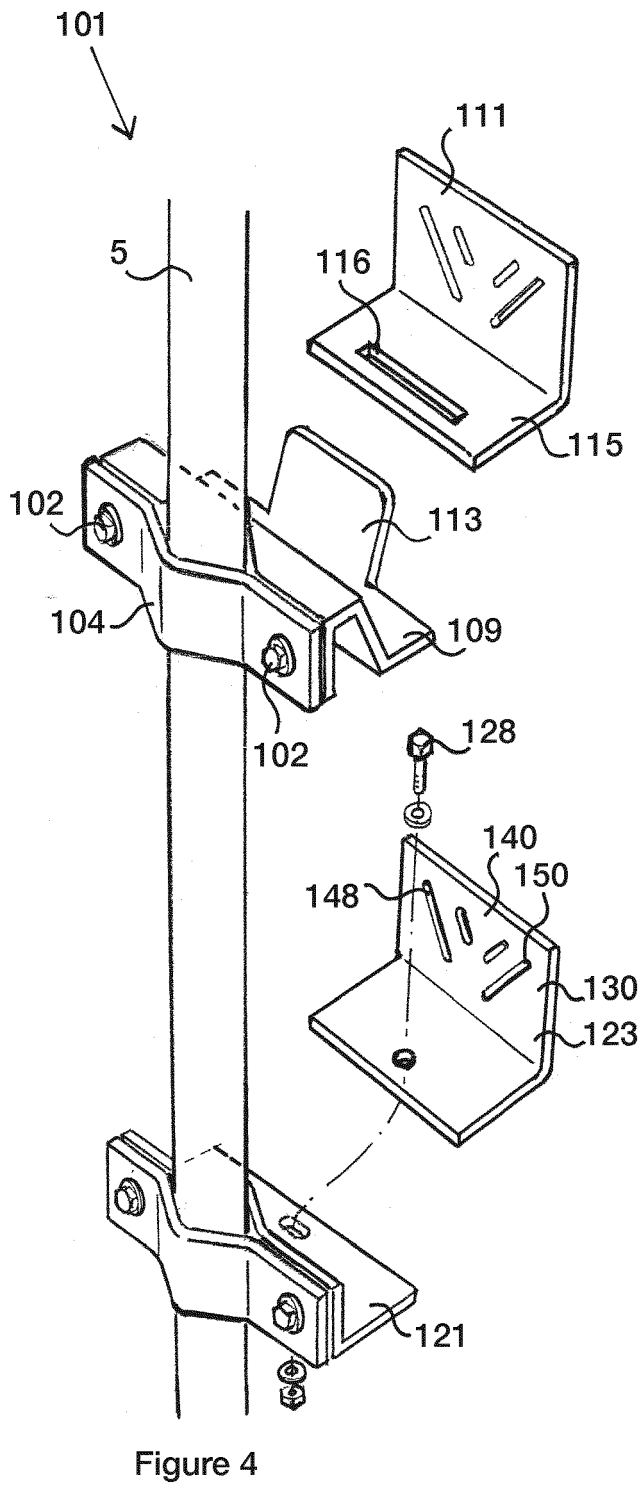


Figure 3



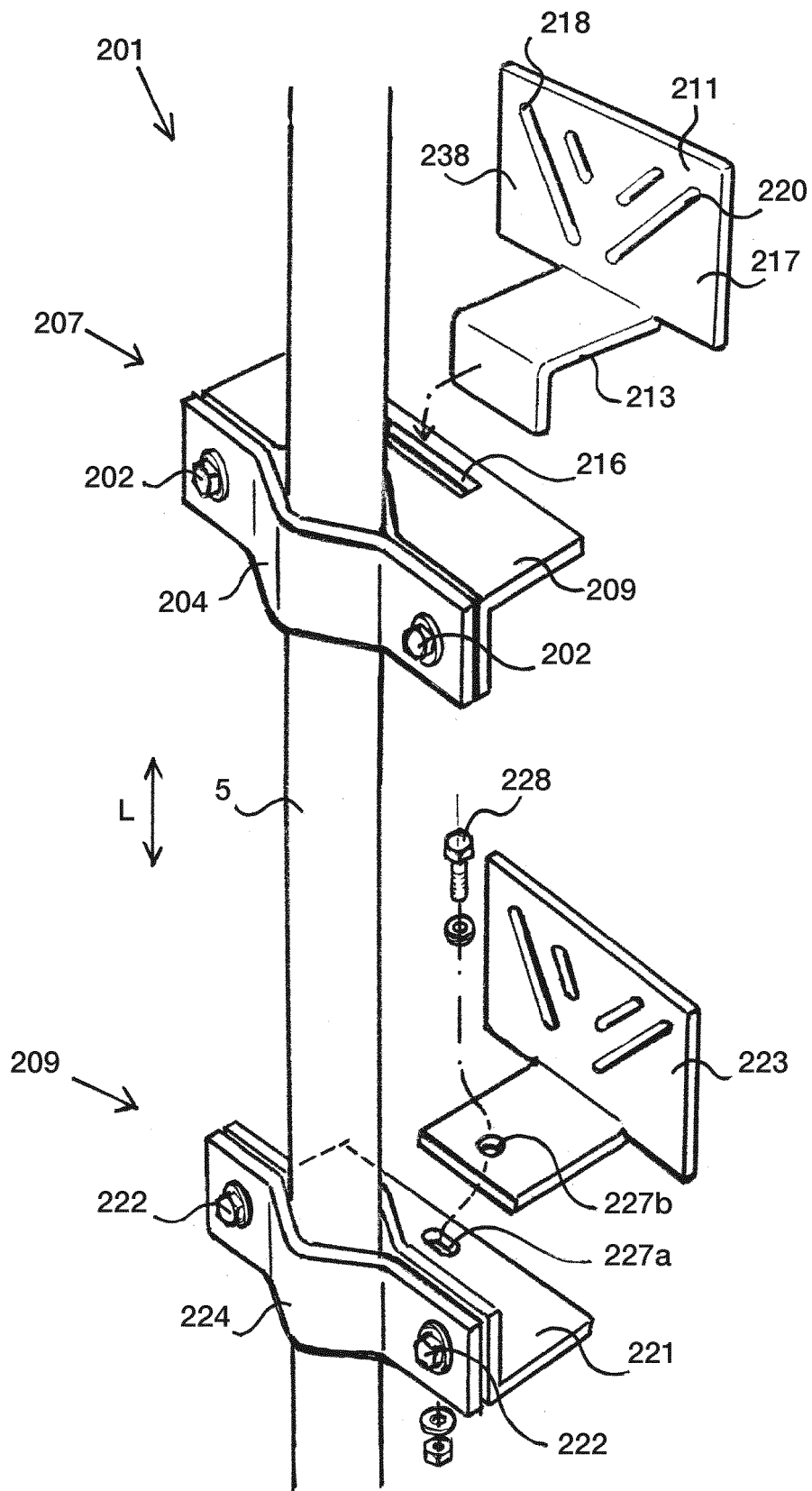


Figure 8



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 19 4355

5

10

15

20

25

30

35

40

45

50

55

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	JP 5 964470 B1 (NIPPON DENGYO KOSAKU CO LTD) 3 August 2016 (2016-08-03) * paragraphs [0006], [0009], [0014] - [0015], [0018] - [0039], [0054] - [0056]; figures 3,4,6-8,12 *	1-15	INV. H01Q1/12
A	Panel Antenna: "Standalone Panel Antenna ARC-PA3520B01", 31 May 2012 (2012-05-31), XP055455038, Retrieved from the Internet: URL:http://web.archive.org/web/20120531023836if_/http://www.antennas.com/wp-content/uploads/2011/12/ARC-PA3520B01_DS_090811.pdf [retrieved on 2018-02-28] * page 1 *	4	
A	JP 2003 234607 A (ANTEN CORP) 22 August 2003 (2003-08-22) * paragraphs [0008], [0010]; figure 1c *	4	TECHNICAL FIELDS SEARCHED (IPC)
A	Wilson Electronics: "Antenna Installation Guide, Dual-Band Panel Antenna", 31 December 2008 (2008-12-31), pages 1-4, XP055458254, Retrieved from the Internet: URL:http://www.wilsonamplifierstore.com/media/pdf/301135.pdf [retrieved on 2018-03-12] * page 3, paragraph 5 - paragraph 8 *	9	H01Q
X	US 2004/066353 A1 (ERNEST EHLEN MATHIAS MARTIN [NZ] ET AL) 8 April 2004 (2004-04-08) * paragraphs [0028], [0037], [0038]; figures 3,13,15 *	1-3,5-8,10-15	
A		9	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 March 2018	Examiner Georgiadis, A
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	

EPO FORM 1503 03.82 (P04C01)

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

EP 17 19 4355

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-03-2018

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 5964470 B1	03-08-2016	CN 105822883 A	03-08-2016
		JP 5964470 B1	03-08-2016
		JP 2016139916 A	04-08-2016
JP 2003234607 A	22-08-2003	NONE	
US 2004066353 A1	08-04-2004	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82