



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.08.2022 Bulletin 2022/35

(51) International Patent Classification (IPC):
H01Q 1/00 ^(2006.01) **H01Q 1/12** ^(2006.01)

(21) Application number: **21760555.9**

(52) Cooperative Patent Classification (CPC):
H01Q 1/00; H01Q 1/12

(22) Date of filing: **27.01.2021**

(86) International application number:
PCT/CN2021/074004

(87) International publication number:
WO 2021/169715 (02.09.2021 Gazette 2021/35)

(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:
KH MA MD TN

(72) Inventors:
• **JIANG, Yu**
Shenzhen, Guangdong 518057 (CN)
• **ZHANG, Gongzhe**
Shenzhen, Guangdong 518057 (CN)
• **CUI, Yunshan**
Shenzhen, Guangdong 518057 (CN)
• **ZHAO, Xifeng**
Shenzhen, Guangdong 518057 (CN)

(30) Priority: **27.02.2020 CN 202010122465**

(74) Representative: **Zoli, Filippo**
Brunacci & Partners S.r.l.
Via Pietro Giardini, 625
41125 Modena (IT)

(71) Applicant: **ZTE Corporation**
Shenzhen, Guangdong 518057 (CN)

(54) **ANTENNA INSTALLATION APPARATUS AND ANTENNA DEVICE**

(57) An antenna installation apparatus and an antenna device. The antenna installation apparatus comprises: a first sleeve joint assembly (40), a connecting assembly (30), and an installation assembly (60). The first sleeve joint assembly (40) is configured to be sleeved on a support rod (20). The installation assembly (60) is located on the side of the first sleeve joint assembly (40)

along a predetermined direction. One end of the connecting assembly (30) is connected to the installation assembly (60), and the other end of the connecting assembly (30) is configured to connect to an antenna apparatus (10). The predetermined direction is the length direction of the support rod (20).

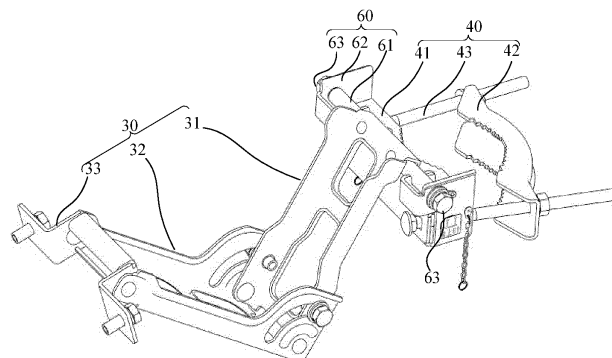


FIG. 3

Description**CROSS-REFERENCE TO RELATED APPLICATION**

[0001] The present application is filed on the basis of the Chinese patent application No. 202010122465.X filed on February 27, 2020, and claims priority of the Chinese patent application, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to the field of mechanical designs, in particular to an antenna installation apparatus and an antenna device.

BACKGROUND

[0003] With the advent of the 5G era, 5G antennas have begun to be laid on a large scale. There are various installation scenarios for antenna apparatuses, including many installation scenarios in small spaces, for example, an antenna apparatus is installed in a beautification hood. A 5G antenna has high integration, heavy weight and large overall size, so it is a huge challenge for the 5G antenna to meet the installation and use requirements in a narrow space while replacing a 4G antenna. At present, when being installed, an antenna apparatus is installed on a support rod by means of an antenna installation apparatus, so there is a certain distance between the antenna apparatus and the support rod. In order to meet the requirements of antenna installation in a narrow space, it is an urgent technical problem to be solved in this field about how to reduce the distance between the antenna apparatus and the support rod.

SUMMARY

[0004] In order to solve one of the above technical problems at least to a certain extent, the present invention provides an antenna installation apparatus, including: a first sheathing assembly, a connection assembly and an installation assembly. The first sheathing assembly is configured to be sheathed on a support rod, the installation assembly is located at one side of the first sheathing assembly in a predetermined direction, one end of the connection assembly is connected to the installation assembly, and the other end of the connection assembly is configured to be connected to an antenna apparatus. The predetermined direction is a length direction of the support rod.

[0005] The present invention further provides an antenna device, including: an antenna apparatus and the above-mentioned antenna installation apparatus, where the antenna apparatus is connected to the connection assembly.

BRIEF DESCRIPTION OF DRAWINGS

[0006] The drawings are provided for a further understanding of the present invention and constitute a part of the description, are used to explain the present invention together with the following specific embodiments, but do not constitute a limitation to the present invention. In the drawings:

Fig. 1 is a schematic diagram of an antenna apparatus provided in a comparative example installed on a support rod;

Fig. 2 is a schematic diagram showing the connection between a first connection arm of a connection assembly and a first sheathing assembly provided in the comparative example;

Fig. 3 is a schematic diagram showing a first connection state of a first sheathing assembly, a connection assembly and an installation assembly provided in some embodiments of the present invention;

Fig. 4 is a schematic diagram showing a second connection state of a first sheathing assembly, a connection assembly and an installation assembly provided in some embodiments of the present invention;

Fig. 5 is a schematic diagram of the connection assembly shown in Fig. 4;

Fig. 6 is a schematic diagram showing the connection between a first connection arm and an installation shaft provided in some embodiments of the present invention;

Fig. 7 is a schematic structural diagram of a second connection arm provided in some embodiments of the present invention;

Fig. 8 is a schematic diagram of a first support base provided in some embodiments of the present invention;

Fig. 9 is a schematic diagram of a first sheathing assembly and an installation plate, as well as a support component and an installation plate provided in some embodiments of the present invention;

Fig. 10 is a schematic diagram of a first front fastener, an installation plate and a support component provided in some embodiments of the present invention;

Fig. 11 is a schematic diagram of a first rear fastener provided in some embodiments of the present invention;

Fig. 12 is a schematic diagram of a first sheathing

assembly, a connection assembly and an installation assembly provided in other embodiments of the present invention;

Fig. 13 is a schematic diagram of installing an antenna apparatus on a support rod by means of an antenna installation apparatus provided in some embodiments of the present invention;

Fig. 14 is a schematic diagram of a second sheathing assembly and a second support base provided in some embodiments of the present invention;

Fig. 15 is a schematic structural diagram of a second front fastener and a fixing plate on the second front fastener shown in Fig. 14; and

Fig. 16 is a schematic diagram of a second sheathing assembly and a second support base provided in other embodiments of the present invention.

DETAILED DESCRIPTION

[0007] Specific embodiments of the present invention will be described below in detail in conjunction with the accompanying drawings. It should be understood that the specific embodiments described here are only used to describe and explain the present invention, and are not used to limit the present invention.

[0008] Fig. 1 is a schematic diagram of an antenna apparatus provided in a comparative example installed on a support rod. As shown in Fig. 1, an antenna apparatus 10 is installed on a support rod 20 by means of an antenna installation apparatus. The antenna installation apparatus includes: a connection assembly 30, and a first sheathing assembly 40 and a second sheathing assembly 50 which are sheathed on the support rod 20. The connection assembly 30 is installed on the first sheathing assembly 40, and the antenna apparatus 10 is connected to the connection assembly 30 and the second sheathing assembly 50. The connection assembly 30 includes two first connection arms 31 and a second connection arm. The first connection arms 31 are connected to the first sheathing assembly 40. By adjusting an included angle between each first connection arm 31 and the second connection arm, an installation angle of the antenna apparatus may be adjusted. Fig. 2 is a schematic diagram showing the connection between the first connection arms of the connection assembly and the first sheathing assembly provided in the comparative example. As shown in Fig. 2, a convex portion 40a is arranged at the right side of the first sheathing assembly 40, each first connection arm 31 is arranged on the convex portion 40a by means of screws or other fastening structures, and a certain distance is kept between the first connection arm 31 and the first sheathing assembly 40, so that the first connection arm 31 may be adjusted to different angles. In addition, the convex portion 40a also has a large

width, which leads to a large distance d_1 between the antenna apparatus 10 and the support rod 20.

[0009] In an installation scenario of a narrow space, for example, when the antenna apparatus 10 is installed in a beautification hood, if the distance between the antenna apparatus 10 and the support rod 20 is large, the antenna apparatus 10 is nearly attached to the wall surface of the beautification hood closely, resulting in the following problems: limited operation space for installation, great difficulty in installation; difficult adjustment of antenna angles (for example, an azimuth angle and a dip angle), which affects a signal coverage direction; and small remaining space in the beautification hood, which affects an air duct and is not beneficial to heat dissipation of an antenna.

[0010] An embodiment of the present invention provides an antenna installation apparatus. The antenna installation apparatus includes: a first sheathing assembly, a connection assembly and an installation assembly. Fig. 3 is a schematic diagram showing a first connection state of a first sheathing assembly, a connection assembly and an installation assembly provided in some embodiments of the present invention; and Fig. 4 is a schematic diagram showing a second connection state of a first sheathing assembly, a connection assembly and an installation assembly provided in some embodiments of the present invention. As shown in Figs. 3 and 4, the first sheathing assembly 40 is configured to be sheathed on the support rod, the installation assembly 60 is located at one side of the first sheathing assembly 40 in a predetermined direction, one end of the connection assembly 30 is connected to the installation assembly 60, and the other end of the connection assembly 30 is configured to be connected to an antenna apparatus. The predetermined direction is a length direction of the support rod. "The installation assembly 60 is located at one side of the first sheathing assembly 40 in a predetermined direction", that is, when the first sheathing assembly 40 is sheathed on the upright support rod, the installation assembly 60 is located above or below the first sheathing assembly 40.

[0011] In an embodiment of the present invention, the installation assembly 60 is located above or below the first sheathing assembly 40, one end of the connection assembly 30 is connected to the installation assembly 60, and the other end of the connection assembly is connected to the antenna apparatus. Compared with the way of connecting the connection assembly 30 to the convex portion 40a at the right side of the first sheathing assembly 40 in Fig. 2, in the antenna installation apparatus of the embodiment of the present invention, no gap is kept between the connection assembly 30 and the first sheathing assembly 40 in a horizontal direction, and moreover, when the first sheathing assembly 40 is sheathed on the support rod, even if the width of the installation assembly 60 is large, the distance between the antenna apparatus and the support rod cannot be increased, so that the antenna apparatus may be closer to the support rod, which is beneficial to the installation

of the antenna apparatus in a narrow space.

[0012] In some embodiments, as shown in Fig. 3, the installation assembly 60 includes an installation shaft 61, installation plates 62 located at both sides of the installation shaft 61 in an axial direction, and first locking components 63 arranged on the installation plates 62.

[0013] Fig. 5 is a schematic diagram of the connection assembly shown in Fig. 4. Referring to Figs. 3 to 5, the connection assembly 30 includes: a first connection arm 31 and a second connection arm 32. The first end of the first connection arm 31 is fixedly connected to the installation shaft 61, the second end of the first connection arm 31 is rotatably connected to the first end of the second connection arm 32, and the second end of the second connection arm 32 is configured to be connected to the antenna apparatus. The first locking components 63 are configured to keep the installation shaft 61 and the installation plates 62 relatively fixed when a first target angle is formed between a length direction of the first connection arm 31 and the predetermined direction. The length direction of the first connection arm 31 refers to a direction from the first end to the second end of the first connection arm 31. The first target angle may be set as required.

[0014] The second end of the second connection arm 32 may be indirectly connected to the antenna apparatus. For example, as shown in Figs. 3 and 5, the connection assembly 30 further includes a first support base 33, and the second end of the second connection arm 32 is indirectly connected to the antenna apparatus by means of the first support base 33.

[0015] Fig. 6 is a schematic diagram showing the connection between the first connection arm and the installation shaft provided in some embodiments of the present invention. As shown in Fig. 6, the end faces of both ends of the installation shaft 61 are provided with a threaded hole 61v respectively, and the installation plates 62 are provided with a through hole 62v respectively (as shown in Fig. 10). The threaded hole 61v in the installation shaft 61 is directly opposite to the through hole 62v in the installation plates 62. The first locking component 63 shown in Fig. 3 includes a screw that passes through the through hole 62v and is screwed into the threaded hole 61v. During the installation of the antenna apparatus, the threaded hole 61v in the installation shaft 61 is aligned with the through hole 62v in the installation plates 62, and the first connection arm 31 is rotated to an appropriate angle. Then, the first locking component 63 is screwed into the threaded hole 61v, so that the two installation plates 62 press the installation shaft 61 therebetween.

[0016] The first connection arm 31 is a sheet-metal structural component, including: a first main plate portion 311 and two first side plate portions 312. The two first side plate portions 312 are arranged at both sides of the first main plate portion 311 in a width direction, and are integrally connected with the first main plate portion 311. It should be understood that the first main plate portion

311 does not necessarily have a full-face structure, for example, the first main plate portion 311 may be provided with a hollow pattern. One end of the first main plate portion 311 is connected to the installation shaft 61, for example, the first main plate portion 311 may be connected to the installation shaft 61 by connection components 311a such as revolving rivets.

[0017] Fig. 7 is a schematic structural diagram of a second connection arm provided in some embodiments of the present invention. The second connection arm 32 is also a sheet-metal structural component. As shown in Fig. 7, the second connection arm 32 includes: a second main plate portion 321 and two second side plate portions 322. The two second side plate portions 322 are located at both sides of the second main plate portion 321 in a width direction, and the first connection arm 31 is rotatably connected to the second side plate portion 322. In this way, when an included angle between the first connection arm 31 and the second connection arm 32 is zero (that is, the first main plate portion 311 is parallel to the second main plate portion 321), the first connection arm 31 is embedded between the two second side plate portions 322 of the second connection arm 32, thus making the structure of the connection assembly 30 more compact.

[0018] Referring to Figs. 5 to 7, the first connection arm 31 is rotatably connected to the corresponding second side plate portion 322 by a revolving rivet 34. For example, the first side plate portion 312 is provided with a through hole 121, the second side plate portion 322 is provided with a through hole 3221, and the first connection arm 31 and the second connection arm 32 are rotatably connected by a revolving rivet 34 penetrating through the through hole 3121 and the through hole 3221. The method of rotationally connecting the first connection arm 31 and the second connection arm 32 by the revolving rivet 34 is easy to realize and is low in cost.

[0019] In addition, the second side plate portion 322 is provided with an arc-shaped hole 3222. The first connection arm 31 is provided with a second locking component 35. The second locking component 35 passes through the arc-shaped hole 3222. The second locking component 35 is configured to slide along the arc-shaped hole 3222 when the first connection arm 31 and the second connection arm 32 rotate relatively, and keep the first connection arm 31 and the second connection arm 32 relatively fixed when a second target angle is formed between the first connection arm 31 and the second connection arm 32. The first target angle and the second target angle may be set according to a tilt angle required by the antenna apparatus. The tilt angle range of the antenna apparatus may be limited by means of the arc-shaped hole 3222 and the second locking component 35.

[0020] In an example, the second locking component 35 is a screw, a nut 36 is fixed on the inner side of the first side plate portion 312, a through hole 3122 is formed in a position, directly opposite to the nut 36, of the first side plate 312, and the second locking component 35

passes through the arc-shaped hole 3222 and the through hole 3122 and is connected to the nut 36. If the second locking component 35 and the nut 36 are screwed, the first connection arm 31 and the second connection arm 32 are kept relatively fixed.

[0021] Fig. 8 is a schematic diagram of a first support base provided in some embodiments of the present invention. Referring to Figs. 5, 7 and 8, the first support base 33 includes a first support plate 331 and a first adapter plate connected to the first support plate 331. The first support plate 331 is configured to be connected to the antenna apparatus, and the first adapter plate 332 is rotatably connected to the second connection arm 32.

[0022] The first support base 33 includes two first support plates 331 and two first adapter plates 332. The two first adapter plates 332 are connected by a first connection plate 333. The first support plate 331 is provided with a through hole 331v, and when the first support plate is connected to the antenna device, the antenna apparatus is fixedly connected with the first support plate 331 by a connection component (for example, a screw or the like) passing through the through hole 331v. The first adapter plate 332 is provided with a through hole 332v, the second side plate portion 322 of the second connection arm 32 is provided with a through hole 3223 corresponding to the through hole 332v, and the first adapter plate 332 is connected with the second side plate portion 322 by a revolving rivet 37 penetrating through the through hole 332v and the through hole 3223. The first support plate 331 may be provided with connecting components such as screws, and when the first support plate is connected with the antenna apparatus, the antenna apparatus is fixedly connected with the first support plate 331 by the connecting components such as screws.

[0023] Fig. 9 is a schematic diagram of a first sheathing assembly and an installation plate, as well as a support component and an installation plate provided in some embodiments of the present invention. Referring to Fig. 3 and Fig. 9, the first sheathing assembly 40 includes a first front fastener 41, a first rear fastener 42 and carriage bolts 43 arranged at both ends of the first front fastener 41. The two ends of the first front fastener 41 are respectively connected to the first rear fastener 42 by the carriage bolts 43, so that the first sheathing assembly 40 is sheathed on the support rod, and the first front fastener 41 and the first rear fastener 42 are tightly held on the support rod. The installation assembly 60 is arranged on the first front fastener 41. In addition, a support component 64 is further arranged between the two installation plates 62. A notch 64v is formed at the top of the support component 64, and the installation shaft 61 is supported in the notch 64v. In some examples, the installation plate 62, the support component 64 and the first front fastener 41 are all sheet-metal structural components and are integrally formed.

[0024] Fig. 10 is a schematic diagram of a first front fastener, an installation plate and a support component provided in some embodiments of the present invention.

As shown in Fig. 10, the first front fastener 41 is a shell with an opening, which includes a top plate 411, a bottom plate 412 and a front side plate 413, the front side plate 413 being opposite to the opening of the shell. The installation plates 62 and the support component 64 are arranged on the top plate 411 of the first front fastener 41. Fig. 11 is a schematic diagram of a first rear fastener provided in some embodiments of the present invention. Referring to Figs. 9 to 11, the first rear fastener 42 includes a top plate 421, a bottom plate 423 and a side plate 422. The side plate 422 of the first rear fastener 42 is provided with through holes 422v and 422h, the front side plate 413 of the first front fastener 41 is provided with two through holes 413v, and each carriage bolt 43 passes through the through hole 413v in the first front fastener 41 and the through hole 422v/422h in the first rear fastener 42.

[0025] In some examples, the through hole 422h is a semi-closed through hole. In this way, before the antenna installation apparatus is installed on the support rod, the first carriage bolt 43 may be made to pass through one through hole 413v in the first front fastener 41 and the through hole 422v in the first rear fastener 42, and the second carriage bolt 43 may be made to only pass through the other through hole 413v in the first front fastener 41; and after the first sheathing assembly 40 is sheathed on the support rod, the second carriage bolt 43 is inserted into the through hole 422h from the notch of the through hole 422h.

[0026] It should be noted that the carriage bolts 43 in the embodiments of the present invention are only described exemplarily, and other connection components may be used to connect the first front fastener 41 and the first rear fastener 42.

[0027] As shown in Fig. 10, the top plate 411 of the first front fastener 41 may be provided with a limiting hole 411v, and the bottom plate 412 may be provided with a limiting hole 412v. In this case, the first sheathing assembly 40 may not be provided with the first rear fastener 42. Referring to Fig. 12, Fig. 12 is a schematic diagram of a first sheathing assembly, a connection assembly and an installation assembly provided in other embodiments of the present invention. The first sheathing assembly 40 includes: a first front fastener 41, a first hoop 44 and a first clamping and fixing component 45. The first hoop 44 is configured to be sheathed and tightly held on the support rod. As mentioned above, the first front fastener 41 is a shell with an opening, and a part of the first hoop 44 extends from the opening into and is fixed in the shell. The first clamping and fixing component 45 is located at the opening of the shell, is connected between the top plate 411 and the bottom plate 412, and is configured to clamp and fix a part of the first hoop 44 between the top plate 411 and the bottom plate 412. In an example, the first clamping and fixing component 45 is a screw that passes through the limiting hole 411v in the top plate 411 and the limiting hole 412v in the bottom plate 412. The first hoop 44 is provided with a size adjustment compo-

nent 441 configured to adjust a diameter of the first hoop 44, so that the first hoop 44 may be tightly held on the support rod.

[0028] Fig. 13 is a schematic diagram of installing an antenna apparatus on a support rod by means of an antenna installation apparatus provided in some embodiments of the present invention. As shown in Fig. 13, in order to stably install the antenna apparatus 10, in some examples, the antenna installation apparatus further includes: a second sheathing assembly 50 and a second support base 70. The second sheathing assembly 50 is configured to be sheathed on the support rod 20 and is located below the first sheathing assembly 40. Fig. 14 is a schematic diagram of a second sheathing assembly and a second support base provided in some embodiments of the present invention. As shown in Fig. 14, the second support base 70 includes: a second support plate 71 and a second adapter plate 72 connected to the second support plate 71. The second support plate 71 is configured to be connected to the antenna apparatus 10, and the second adapter plate 72 is rotatably connected to the second sheathing assembly 50. Two second adapter plates 72 may be fixedly connected by a second connection plate 73.

[0029] The second sheathing assembly 50 may include a second front fastener 51 and a second rear fastener 52. Both ends of the second front fastener 51 are connected to the second rear fastener 52 by carriage bolts 53 (or other connection components) respectively. Fig. 15 is a schematic structural diagram of the second front fastener and a fixing plate on the second front fastener shown in Fig. 14. Referring to Figs. 14 and 15, the second sheathing assembly 50 further includes two fixing plates 54 arranged on the second front fastener 51. The two fixing plates 54 are located at one side of the second front fastener 51 facing away from the second rear fastener 52, and the two adapter plates 72 of the second support base 70 are rotatably connected with the two fixing plates 54 respectively. The second rear fastener 52 may adopt the same structure as that of the first rear fastener 42, which will not be repeated here.

[0030] Fig. 16 is a schematic diagram of a second sheathing assembly and a second support base provided in other embodiments of the present invention. As shown in Fig. 16, the second sheathing assembly 50 includes a second front fastener 51 and a second hoop 55. The second front fastener 51 is a shell with an opening (as shown in Fig. 15), and a part of the second hoop 55 extends into and is fixed in the second front fastener 51. Like the first front fastener 41, the top plate 511 and the bottom plate 512 of the second front fastener 51 are respectively provided with limiting holes (such as 511v and 512v shown in Fig. 15). The second sheathing assembly 50 further includes a second clamping and fixing component 56 arranged between the top plate 511 and the bottom plate 512 of the second front fastener 51, and the second clamping and fixing component 56 passes through the limiting hole 511v in the top plate 511 and

the limiting hole 512v in the bottom plate 512, thereby keeping the second hoop 55 and the second front fastener 51 relatively fixed.

[0031] In the embodiments of the present invention, when the first sheathing assembly 40 includes a first front fastener 41, a first rear fastener 42 and carriage bolts 43, the second sheathing assembly 50 adopts the structure shown in Fig. 14, that is, the second sheathing assembly 50 includes a second front fastener 51, a second rear fastener 52, carriage bolts 53 and fixing plates 54; and when the first sheathing assembly 40 includes a first front fastener 41, a first hoop 44 and a first clamping and fixing component 45, the second sheathing assembly 50 adopts the structure shown in Fig. 16, that is, the second sheathing assembly 50 includes a second front fastener 51, a second hoop 55 and a second clamping and fixing component 56.

[0032] An embodiment of the present invention further provides an antenna device. As shown in Fig. 13, the antenna device includes: an antenna apparatus 10 and the antenna installation apparatus provided in the embodiment of the present invention. The first sheathing assembly 40 is sheathed on the support rod 20, and the connection assembly 30 is connected with the antenna apparatus 10.

[0033] As shown in Fig. 13, the antenna installation apparatus includes a second sheathing assembly 50. The first sheathing assembly 40 is located above the second sheathing assembly 50. In some examples, as shown in Fig. 13, the top of the connection assembly 30 does not exceed the top of the antenna apparatus 10. Compared with the structure in which the connection assembly 30 protrudes from the antenna apparatus 10 shown in Fig. 1, the embodiment of the present invention can make the structure of the antenna installation apparatus more compact, facilitating the installation of the antenna apparatus in a narrow space.

[0034] It can be seen from the above description of the antenna installation apparatus and the antenna device provided in the embodiments of the present invention that in the embodiments of the present invention, the installation assembly 60 is located above or below the first sheathing assembly 40, thereby reducing a distance between the antenna apparatus and the support rod. As shown in Fig. 13, when the antenna apparatus 10 is in an upright state, the distance between the antenna apparatus 10 and the support rod 20 is small. In addition, the top of the connection assembly 30 does not exceed the top of the antenna apparatus 10, thereby facilitating the installation of the antenna apparatus 10 in a narrow space. Moreover, in the antenna installation apparatus, revolving rivets are used for connection in a plurality of positions, reducing the cost and facilitating the installation.

[0035] In the embodiments of the present invention, the installation assembly is located at one side of the first sheathing assembly in a predetermined direction, the predetermined direction is a length direction of the sup-

port rod, that is, when the first sheathing assembly is sheathed on the support rod, the installation assembly is located above or below the first sheathing assembly. One end of the connection assembly is connected to the installation assembly, and the other end of the connection assembly is connected to the antenna apparatus. Therefore, no gap is kept between the connection assembly and the first sheathing assembly in a horizontal direction, so that the antenna apparatus may be closer to the support rod, which is beneficial to the installation of the antenna apparatus in a narrow space.

[0036] It can be understood that the above embodiments are only exemplary embodiments adopted to explain the principles of the present invention, but the present invention is not limited thereto. For those having ordinary skill in the art, various variations and improvements can be made without departing from the spirit and essence of the present invention, and all of which should be considered to belong to the protection scope of the present invention.

Claims

1. An antenna installation apparatus, comprising: a first sheathing assembly, a connection assembly and an installation assembly, wherein the first sheathing assembly is configured to be sheathed on a support rod, the installation assembly is located at one side of the first sheathing assembly in a predetermined direction, one end of the connection assembly is connected to the installation assembly, and the other end of the connection assembly is configured to be connected to an antenna apparatus, wherein the predetermined direction is a length direction of the support rod.
2. The antenna installation apparatus of claim 1, wherein the installation assembly comprises: an installation shaft, installation plates located at both sides of the installation shaft in the axial direction, and first locking components arranged on the installation plates; the connection assembly comprises: a first connection arm and a second connection arm, wherein the first end of the first connection arm is fixedly connected to the installation shaft, the second end of the first connection arm is rotatably connected to the first end of the second connection arm, and the second end of the second connection arm is configured to be connected to the antenna apparatus; and the first locking components are configured to keep the installation shaft and the installation plates relatively fixed in response to a first target angle being formed between a length direction of the first connection arm and the predetermined direction.
3. The antenna installation apparatus of claim 2, wherein in each of end faces of the installation shaft is provided with a threaded hole, each of the installation plates is provided with a through hole, and the first locking components each comprises a screw that passes through the through hole and is screwed into the threaded hole.
4. The antenna installation apparatus of claim 2, wherein a support component is arranged between the installation plates at both sides of the installation shaft, a notch is formed at the top of the support component, and the installation shaft is supported in the notch.
5. The antenna installation apparatus of claim 2, wherein the second connection arm comprises: a main plate portion and side plate portions, wherein the side plate portions are located at both sides of the main plate portion in a width direction, and the first connection arm is rotatably connected to the side plate portions; and each of the side plate portions is provided with an arc-shaped hole, the first connection arm is provided with a second locking component, the second locking component passes through the arc-shaped hole and is configured to slide along the arc-shaped hole in response to the first connection arm and the second connection arm rotating relatively, and keep the first connection arm and the second connection arm relatively fixed in response to a second target angle being formed between the first connection arm and the second connection arm.
6. The antenna installation apparatus of claim 5, wherein the first connection arm and the side plate portions are rotatably connected by a revolving rivet.
7. The antenna installation apparatus of claim 2, wherein the connection assembly further comprises: a first support base comprising a first support plate and a first adapter plate connected to the first support plate, wherein the first support plate is configured to be connected to the antenna apparatus, and the first adapter plate is rotatably connected to the second connection arm.
8. The antenna installation apparatus of any one of claims 1 to 7, wherein the first sheathing assembly comprises: a first front fastener, a first rear fastener and connection components arranged at both ends of the first front fastener, wherein two ends of the first front fastener are respectively connected to the rear fastener by the connection components, so that the first front fastener and the first rear fastener are tightly held on the support rod, and the installation assembly is arranged on the first front fastener.
9. The antenna installation apparatus of any one of

claims 1 to 7, wherein the first sheathing assembly comprises: a first front fastener and a hoop, wherein the hoop is configured to be sheathed and tightly held on the support rod, the first front fastener is a shell with an opening, and a part of the hoop extends from the opening into and is fixed in the shell.

10. The antenna installation apparatus of claim 9, wherein the first sheathing assembly further comprises: a clamping and fixing component, wherein the clamping and fixing component is located at the opening of the shell, is connected between a top plate and a bottom plate of the shell, and is configured to clamp and fix a part of the hoop between the top plate and the bottom plate.

11. The antenna installation apparatus of any one of claims 1 to 7, wherein the antenna installation apparatus further comprises: a second sheathing assembly and a second support base,

wherein the second sheathing assembly is configured to be sheathed on the support rod and is located below the first sheathing assembly; and
the second support base comprises: a second support plate and a second adapter plate connected to the second support plate, wherein the second support plate is configured to be connected to the antenna apparatus, and the second adapter plate is rotatably connected to the second sheathing assembly.

12. An antenna device, comprising: an antenna apparatus and an antenna installation apparatus, wherein the antenna installation apparatus is the antenna installation apparatus of any one of claims 1 to 11, and the antenna apparatus is connected to the connection assembly.

13. The antenna device of claim 12, wherein the antenna installation apparatus is the antenna installation apparatus of claim 11, and the top of the connection assembly does not exceed the top of the antenna apparatus.

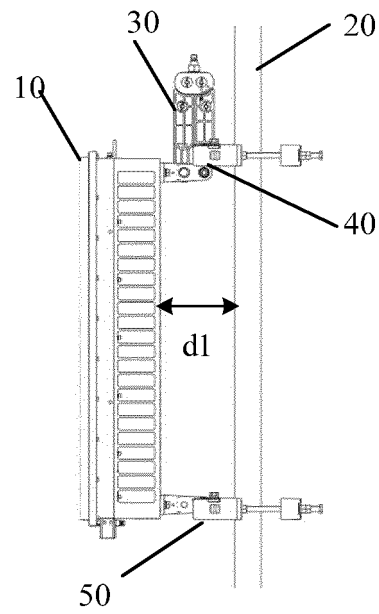


FIG. 1

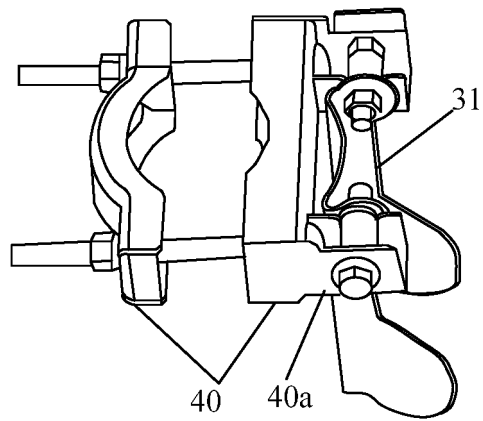


FIG. 2

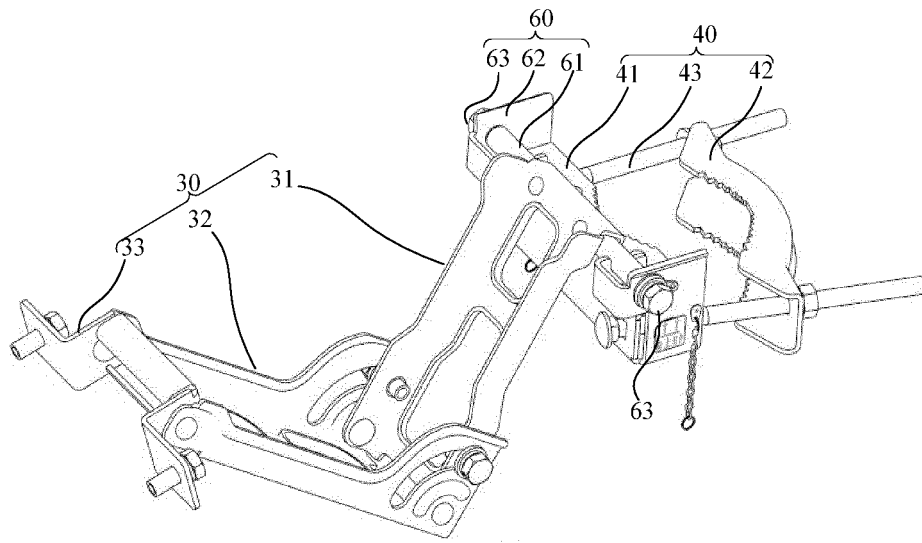


FIG. 3

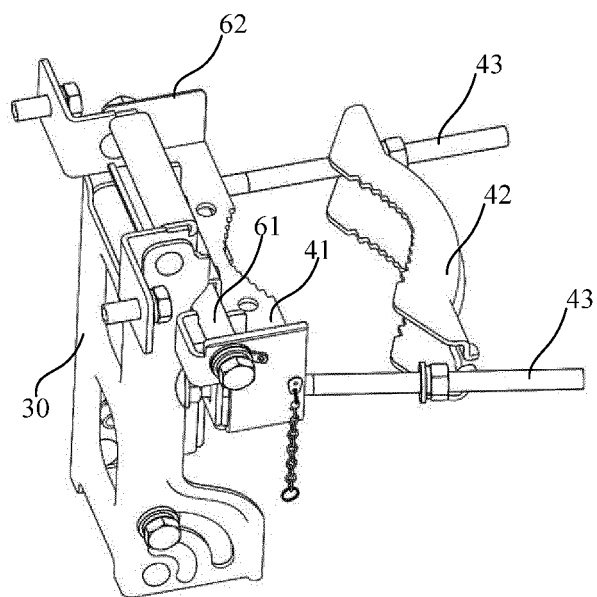


FIG. 4

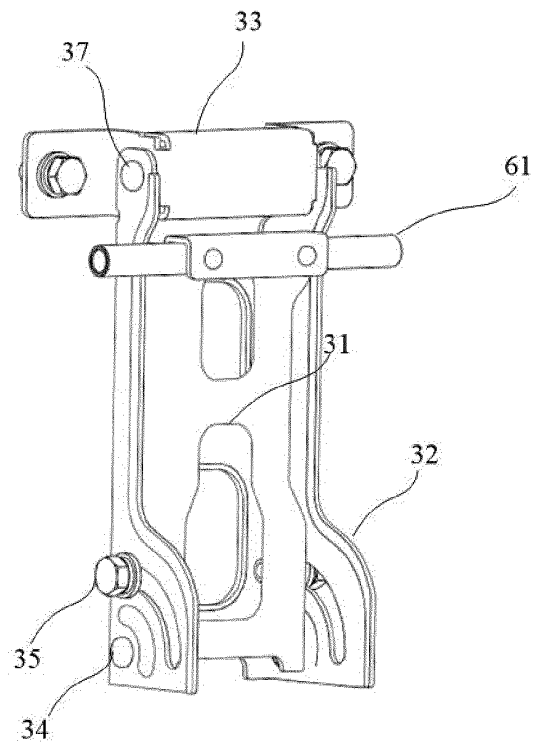


FIG. 5

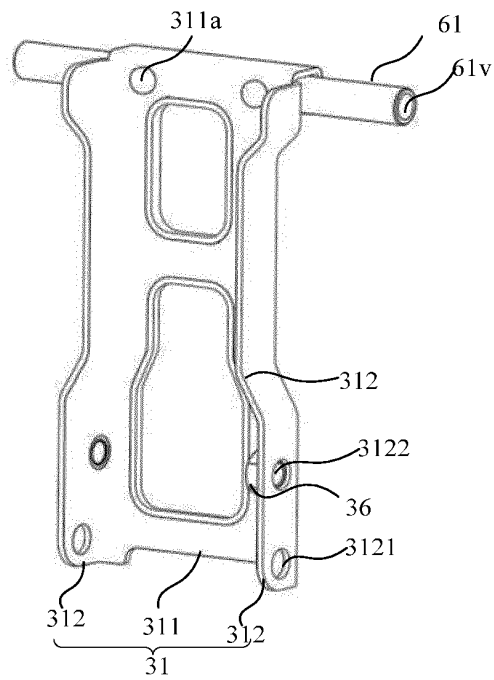


FIG. 6

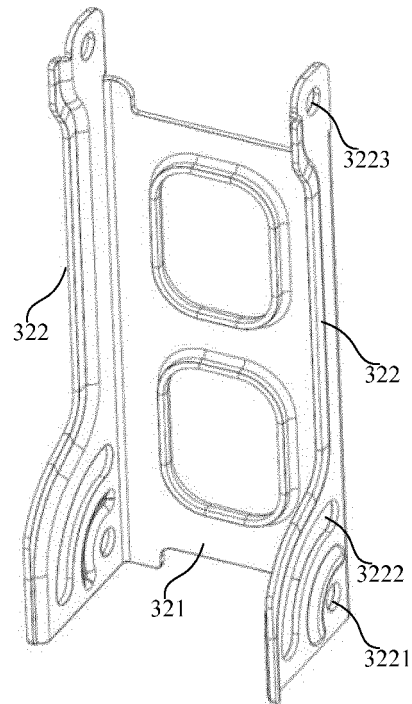


FIG. 7

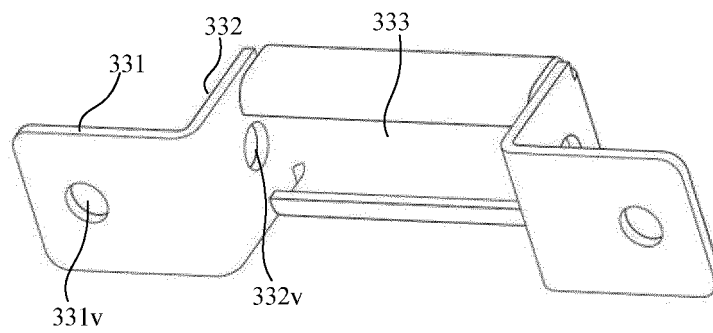


FIG. 8

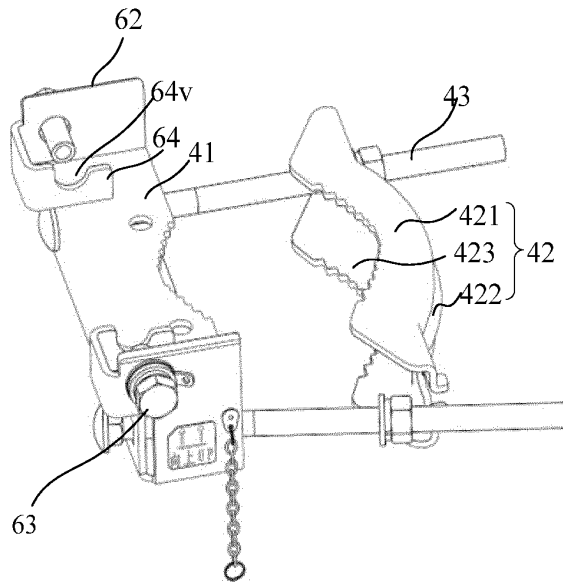


FIG. 9

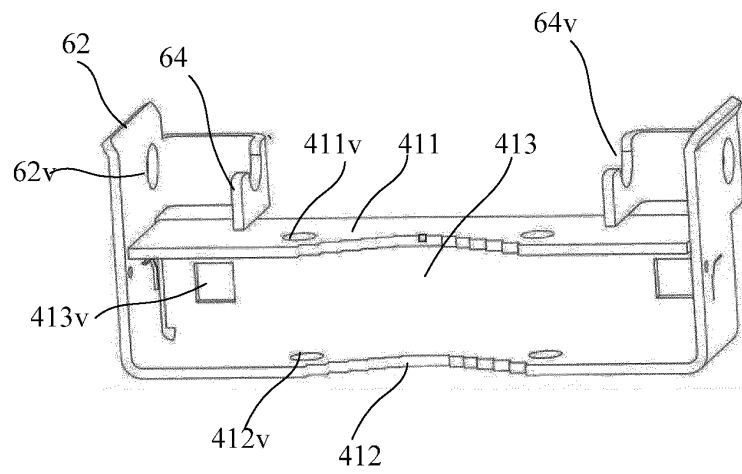


FIG. 10

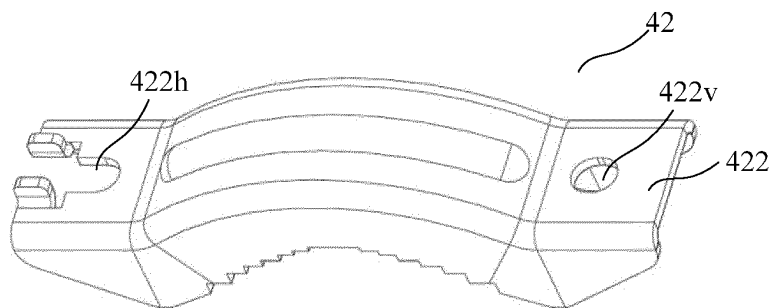


FIG. 11

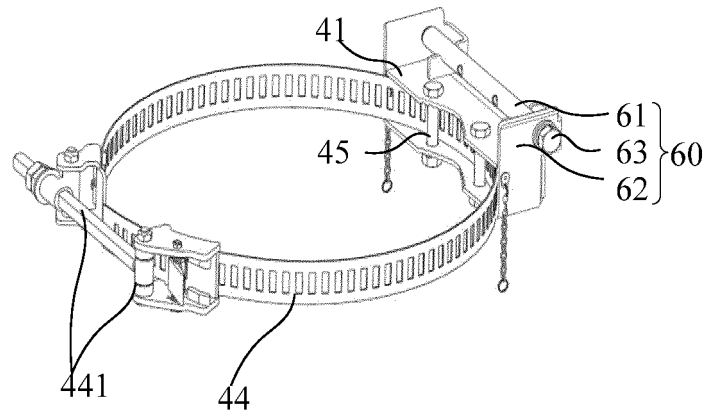


FIG. 12

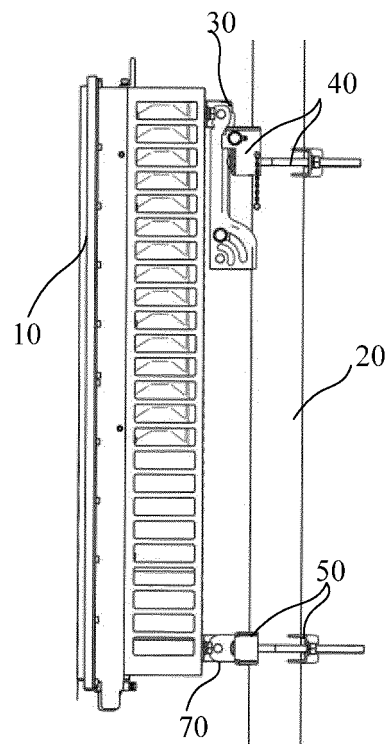


FIG. 13

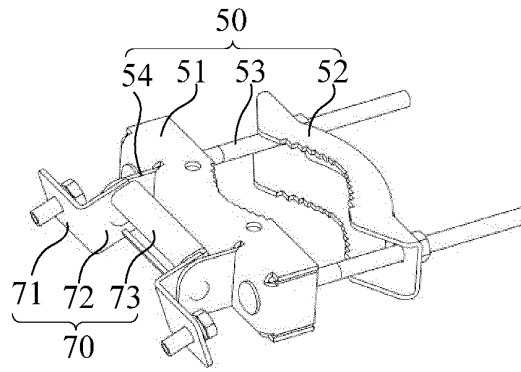


FIG. 14

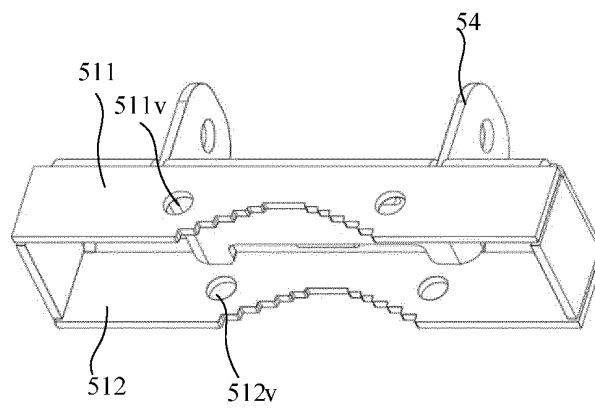


FIG. 15

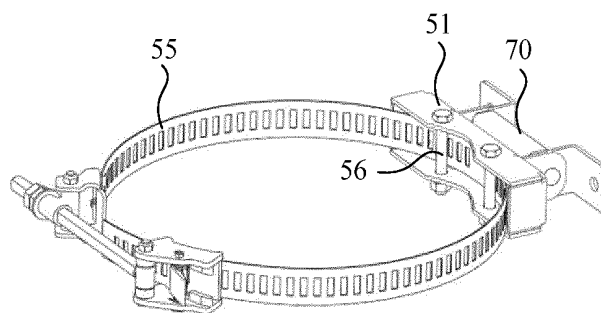


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/074004

A. CLASSIFICATION OF SUBJECT MATTER H01Q 1/00(2006.01)i; H01Q 1/12(2006.01)i 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) VEN; CNTXT; CNABS; CNKI; USTXT; EPTXT; WOTXT; IEEE; 抱杆, 箍, 抱箍, 弧形孔, 弧形槽, 距离, 弧形, 臂, 轴, 间隔, 间距, 杆, 基站天线, base, station, space, antenna, arc, hole, slot, slit, axis, arm, pivot, distance, pole																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15</td> <td>1, 8, 11-13</td> </tr> <tr> <td>Y</td> <td>WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15</td> <td>2, 3, 5-7, 9, 10</td> </tr> <tr> <td>Y</td> <td>CN 2927338 Y (SHENZHEN HUAXING TELECOMMUNICATION EQUIPMENT CO., LTD.) 25 July 2007 (2007-07-25) description page 2 line 12- page 3 line 5; figure 1</td> <td>2, 3, 5-7</td> </tr> <tr> <td>Y</td> <td>CN 208753533 U (RUGAO KK TELECOM MATERIALS CO., LTD.) 16 April 2019 (2019-04-16) description, paragraphs 0034-0037, figures 1-5</td> <td>9, 10</td> </tr> <tr> <td>X</td> <td>CN 204497373 U (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 22 July 2015 (2015-07-22) description paragraph 0035, paragraph 0037; figures 1-3</td> <td>1, 8, 11-13</td> </tr> <tr> <td>X</td> <td>CN 104779441 A (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 15 July 2015 (2015-07-15) description paragraphs 0042-0043; figures 1, 2</td> <td>1, 8, 11-13</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15	1, 8, 11-13	Y	WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15	2, 3, 5-7, 9, 10	Y	CN 2927338 Y (SHENZHEN HUAXING TELECOMMUNICATION EQUIPMENT CO., LTD.) 25 July 2007 (2007-07-25) description page 2 line 12- page 3 line 5; figure 1	2, 3, 5-7	Y	CN 208753533 U (RUGAO KK TELECOM MATERIALS CO., LTD.) 16 April 2019 (2019-04-16) description, paragraphs 0034-0037, figures 1-5	9, 10	X	CN 204497373 U (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 22 July 2015 (2015-07-22) description paragraph 0035, paragraph 0037; figures 1-3	1, 8, 11-13	X	CN 104779441 A (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 15 July 2015 (2015-07-15) description paragraphs 0042-0043; figures 1, 2	1, 8, 11-13	☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15	1, 8, 11-13																				
Y	WO 2018013602 A2 (SENTENIA SYSTEMS INC) 18 January 2018 (2018-01-18) description, paragraphs 58-60, figures 12-15	2, 3, 5-7, 9, 10																				
Y	CN 2927338 Y (SHENZHEN HUAXING TELECOMMUNICATION EQUIPMENT CO., LTD.) 25 July 2007 (2007-07-25) description page 2 line 12- page 3 line 5; figure 1	2, 3, 5-7																				
Y	CN 208753533 U (RUGAO KK TELECOM MATERIALS CO., LTD.) 16 April 2019 (2019-04-16) description, paragraphs 0034-0037, figures 1-5	9, 10																				
X	CN 204497373 U (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 22 July 2015 (2015-07-22) description paragraph 0035, paragraph 0037; figures 1-3	1, 8, 11-13																				
X	CN 104779441 A (HUNAN ZHONGYI COMMUNICATION TECHNOLOGY CO., LTD.) 15 July 2015 (2015-07-15) description paragraphs 0042-0043; figures 1, 2	1, 8, 11-13																				
* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family																					
Date of the actual completion of the international search 12 April 2021	Date of mailing of the international search report 20 April 2021																					
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																					

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/074004

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 110829028 A (WANG, Fan) 21 February 2020 (2020-02-21) description paragraphs 0042-0043; figures 1, 2	1, 8, 11-13
Y	CN 104022356 A (JIANGSU HUACAN TELECOMMUNICATION CO., LTD.) 03 September 2014 (2014-09-03) description, paragraph 0010, figure 1	2, 5-7
Y	CN 2927337 Y (MOBI ANTENNA TECHNOLOGIES (SHENZHEN) CO., LTD.) 25 July 2007 (2007-07-25) description page 3 line 13- page 4 line 24; figures 1-4, 6-9	2, 5-7
Y	CN 209843926 U (ZHONGRUI COMMUNICATION PLANNING AND DESIGN CO., LTD.) 24 December 2019 (2019-12-24) description paragraphs 0036-0038; figures 1, 3	2
Y	CN 2789946 Y (MOBI ANTENNA TECHNOLOGIES (SHENZHEN) CO., LTD.) 21 June 2006 (2006-06-21) description page 2 last paragraph - page 3 paragraph 3 from the bottom; figures 1-9	2, 7
Y	CN 206441852 U (TONGYU COMMUNICATION INC.) 25 August 2017 (2017-08-25) description paragraphs 0025-0031; figures 1, 3	2, 7
Y	CN 205790317 U (TONGYU COMMUNICATION INC.) 07 December 2016 (2016-12-07) description, paragraphs 0027-0028, paragraph 0031, figures 3, 4	2, 7
A	JP 2001292015 A (NIPPON ANTENNA KK) 19 October 2001 (2001-10-19) entire document	1-13

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/074004

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2018013602 A2	18 January 2018	WO 2018013602 A3	26 April 2018
CN 2927338 Y	25 July 2007	None	
CN 208753533 U	16 April 2019	None	
CN 204497373 U	22 July 2015	None	
CN 104779441 A	15 July 2015	CN 104779441 B	31 July 2018
CN 110829028 A	21 February 2020	None	
CN 104022356 A	03 September 2014	None	
CN 2927337 Y	25 July 2007	None	
CN 209843926 U	24 December 2019	None	
CN 2789946 Y	21 June 2006	None	
CN 206441852 U	25 August 2017	None	
CN 205790317 U	07 December 2016	None	
JP 2001292015 A	19 October 2001	None	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202010122465X [0001]