US012394879B2

(12) **United States Patent**
Yoo et al.

(10) **Patent No.: US 12,394,879 B2**
(45) **Date of Patent: *Aug. 19, 2025**

(54) **CLAMPING APPARATUS FOR ANTENNA**

(71) Applicant: **KMW INC.**, Hwaseong-si (KR)

(72) Inventors: **Chang Woo Yoo**, Hwaseong-si (KR); **Jin Soo Yeo**, Hwaseong-si (KR); **In-Ho Kim**, Yongin-si (KR)

(73) Assignee: **KMW INC.**, Hwaseong-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **18/438,471**

(22) Filed: **Feb. 11, 2024**

(65) **Prior Publication Data**

US 2024/0186675 A1 Jun. 6, 2024

Related U.S. Application Data

(63) Continuation of application No. 17/474,072, filed on Sep. 14, 2021, now Pat. No. 11,909,094, which is a (Continued)

(30) **Foreign Application Priority Data**

Mar. 18, 2019 (KR) 10-2019-0030768
Oct. 30, 2019 (KR) 10-2019-0136082

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

(52) **U.S. Cl.**
CPC ***H01Q 1/125*** (2013.01); ***H01Q 1/1228*** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/125; H01Q 1/1228; H01Q 1/1242; H01Q 1/246; H01Q 3/08
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,283,425 B1 9/2001 Liljevik
6,538,613 B1 * 3/2003 Pursiheimo H01Q 3/08 342/359

(Continued)

FOREIGN PATENT DOCUMENTS

CN 201510887109.6 A 2/2016
CN 202020339348 U 2/2021

(Continued)

OTHER PUBLICATIONS

International Search Report mailed Jul. 1, 2020 for International Application No. PCT/KR2020/003723 and its English translation.

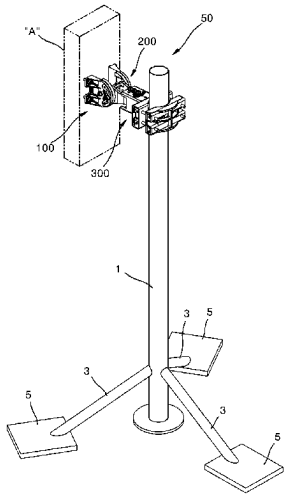
(Continued)

Primary Examiner — David E Lotter
(74) *Attorney, Agent, or Firm* — Insight Law Group, PLLC; Seung Lee

(57) **ABSTRACT**

A clamping apparatus is provided. The clamping apparatus includes: an arm unit configured to be coupled to a support pole and has a mounting space formed in a tip portion thereof; and a rotation unit comprising a rotating block which is configured to be inserted into the mounting space of the arm unit and tilting unit installing stages provided at an opposite side of the rotating block, wherein the rotating block is configured to be detachably mounted in the mounting space of the arm unit and rotatable about a hinge point in the mounting space at a predetermined angle in a left-right direction. The rotating block comprises a mounting guide unit having an upper surface and a lower surface, and the mounting guide unit comprises a guide tube provided on the lower surface and configured to protrude from the lower surface to penetrate a hinge hole provided on a lower surface of the mounting space of the arm unit at a corresponding location of the hinge point.

20 Claims, 18 Drawing Sheets



Related U.S. Application Data

continuation of application No. PCT/KR2020/003723, filed on Mar. 18, 2020.

(56) **References Cited**

U.S. PATENT DOCUMENTS

11,909,094	B2 *	2/2024	Yoo	H01Q 3/08
2012/0234992	A1 *	9/2012	Vanover	H01Q 1/1207 248/201
2014/0118213	A1	5/2014	Blalock et al.	
2021/0408662	A1	12/2021	Yoo et al.	
2022/0029270	A1	1/2022	Yoo et al.	
2022/0037758	A1	2/2022	Kim et al.	
2022/0190473	A1	6/2022	Kim et al.	
2022/0238982	A1	7/2022	Kim et al.	

FOREIGN PATENT DOCUMENTS

KR	10-2009-0017933	A	2/2009
KR	20-2011-0001413	U	2/2011
KR	10-2013-0008946	A	1/2013
KR	10-1719270	B1	3/2017
KR	10-2487110	B1	1/2023

OTHER PUBLICATIONS

Indian Office Action mailed Apr. 4, 2022 for Indian Application No. 202117046890.

Australian Office Action mailed Jul. 19, 2022 for Australian Application No. 2020240972.

Notice of Allowance mailed Oct. 10, 2023 for U.S. Appl. No. 17/474,072.

Non-final Office Action mailed May 9, 2025 from the Chinese Patent Office for Chinese Application No. 202080022832.7.

* cited by examiner

FIG. 1

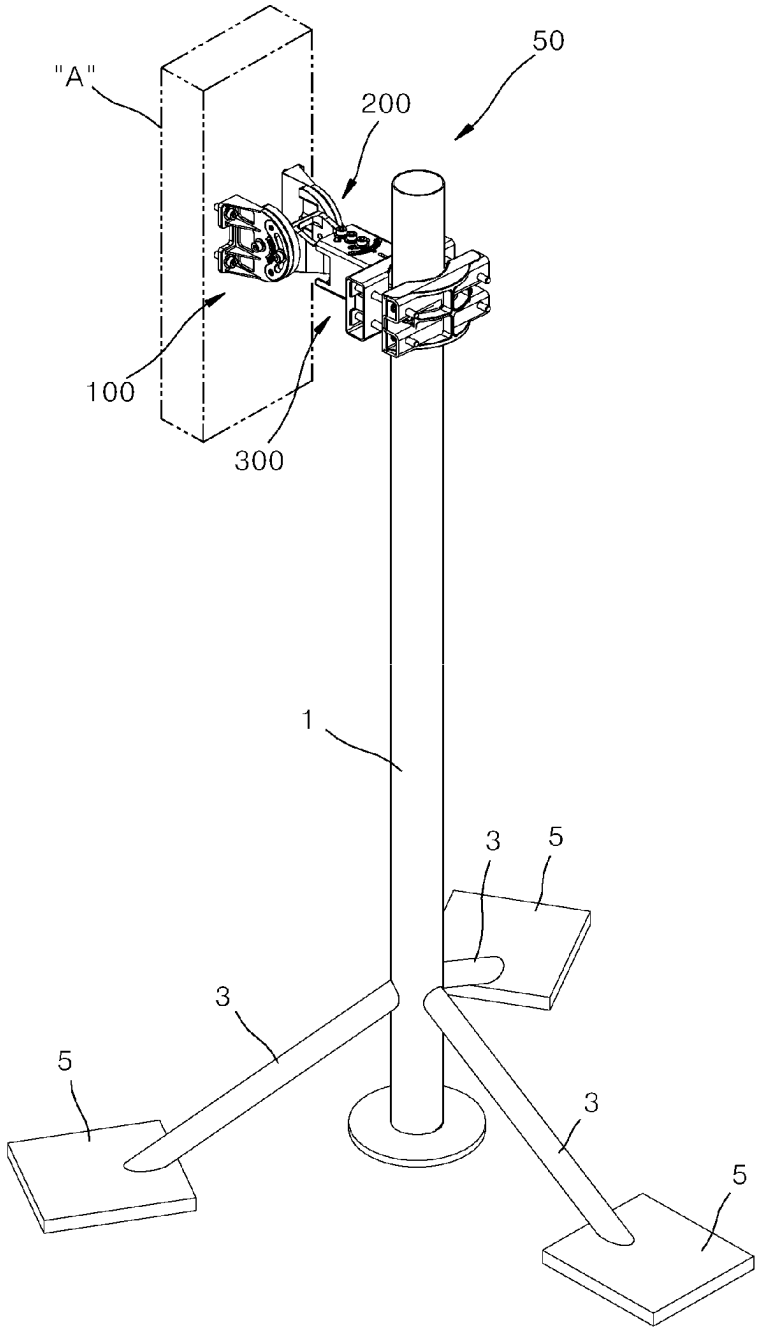


FIG. 2

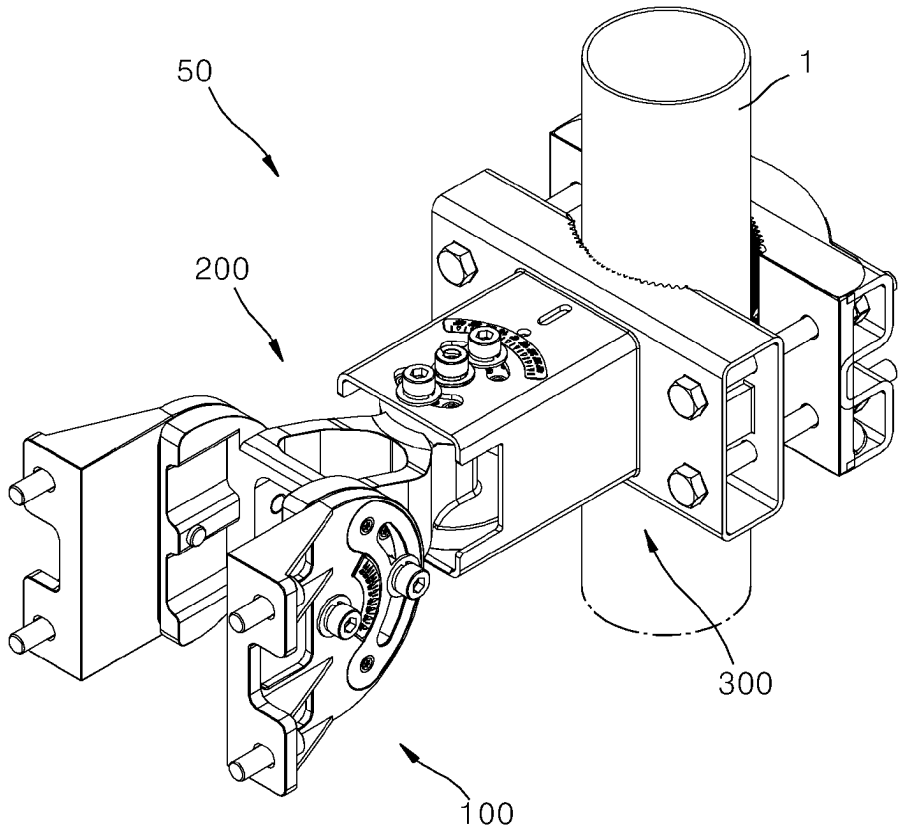


FIG. 3

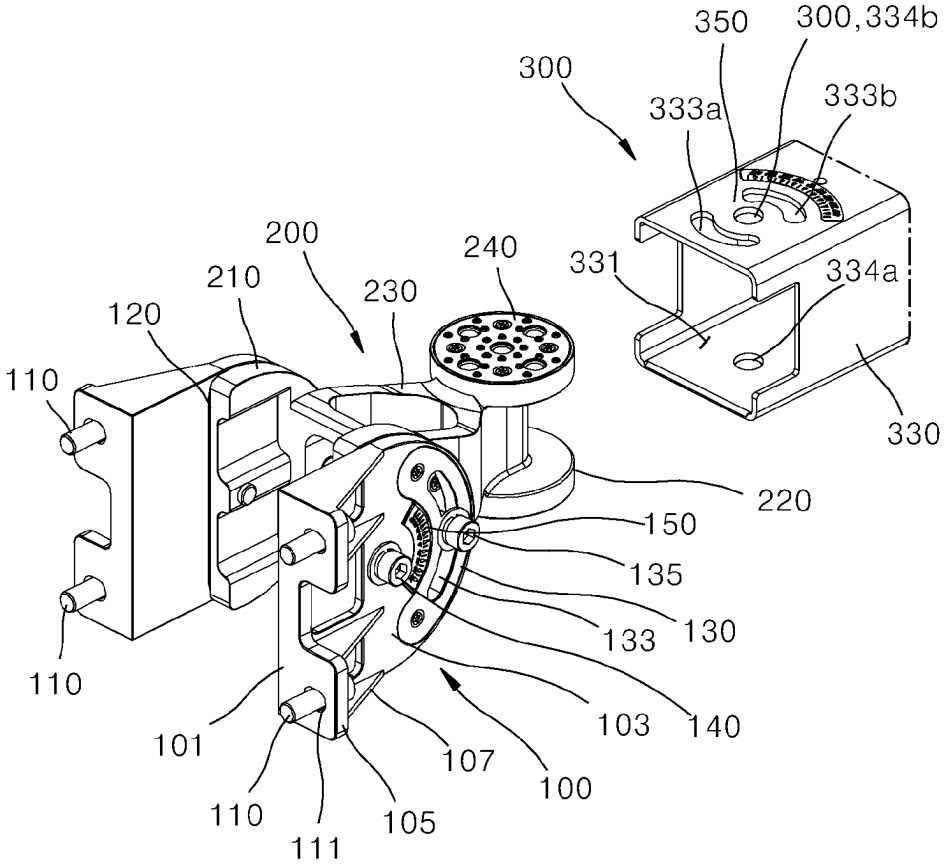

350
300,334b
300
333a
333b
200
240
331
334a
210
230
120
110
330
220
150
135
133
130
110
103
140
101
107
100
110
105
111

FIG. 4

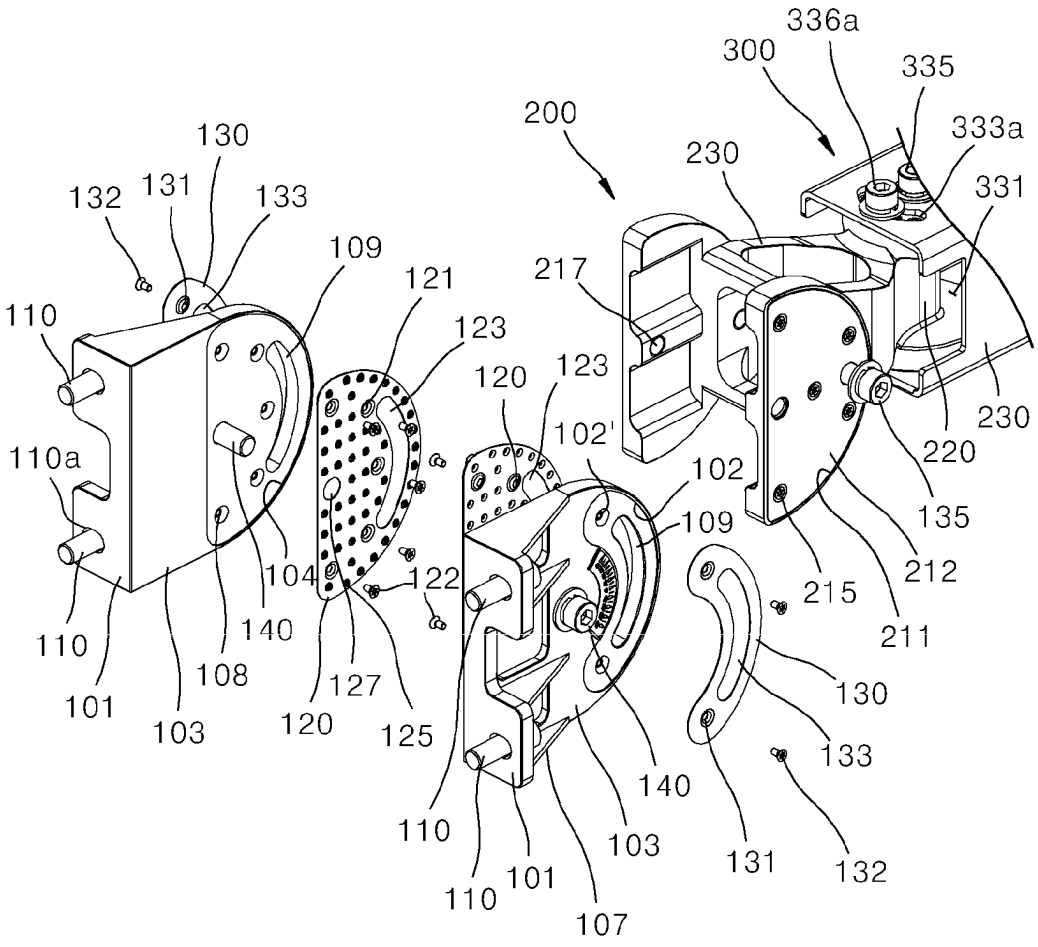

336a
300
335
200
333a
230
331
130
132
131
133
109
121
217
110
123
120
123
102'
230
110a
102
220
109
135
104
122
215
212
140
211
110
108
127
130
101
103
120
125
133
140
110
103
131
132
101
110
107

FIG. 5

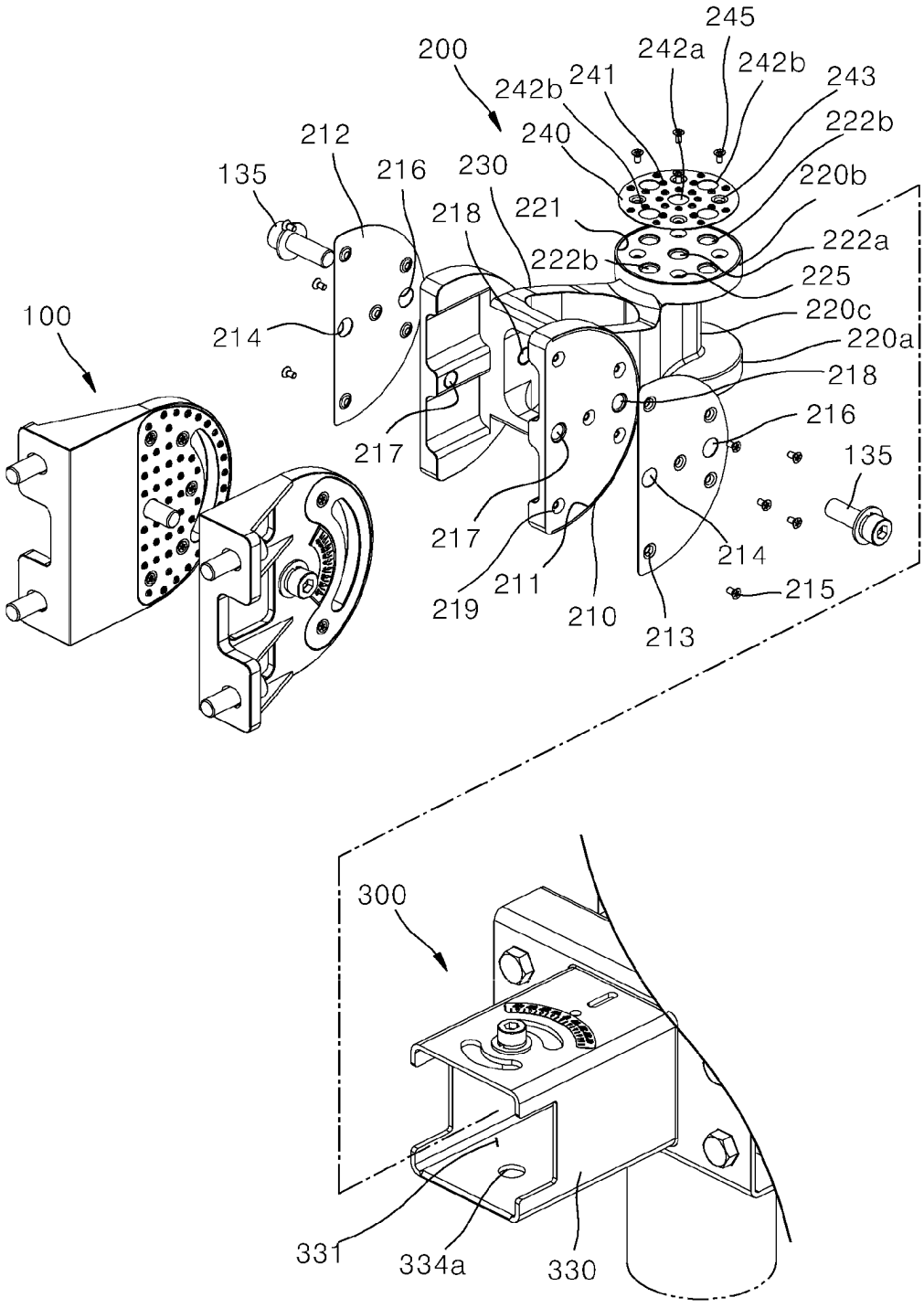

245
200
242a
242b
241
243
242b
222b
240
212
135
216
230
220b
218
221
222a
222b
225
100
220c
214
220a
218
217
216
135
217
214
219
211
210
213
215
300
331
334a
330

FIG. 6

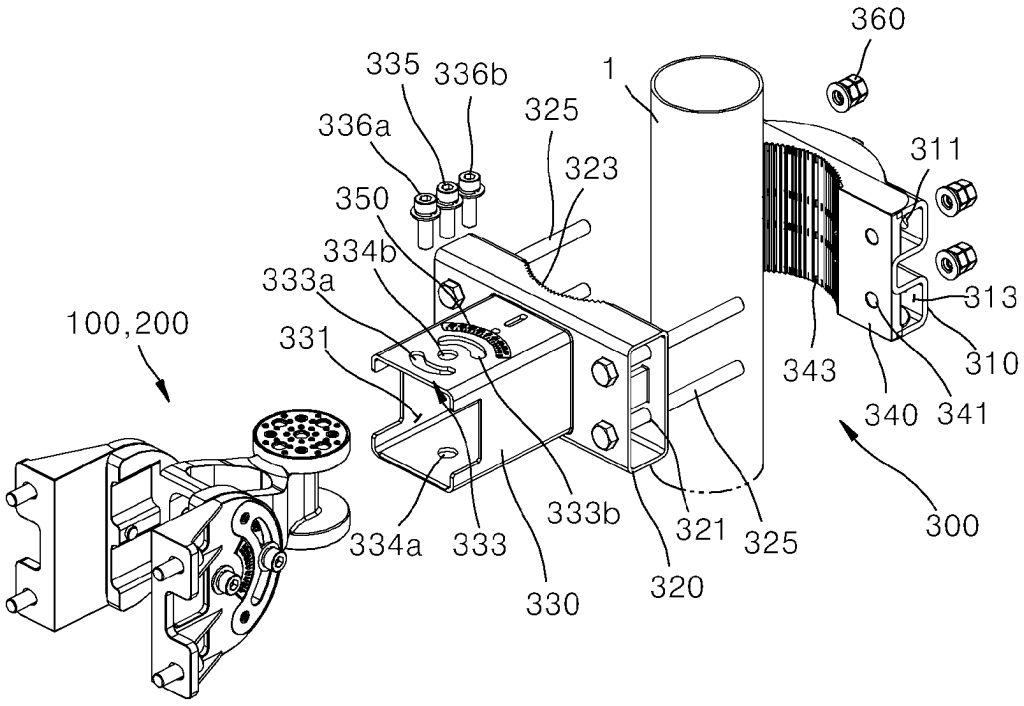

360
335
336b
1
325
336a
323
311
350
334b
333a
313
100,200
331
343
310
340
341
333b
321
325
300
334a
333
330
320

FIG. 7

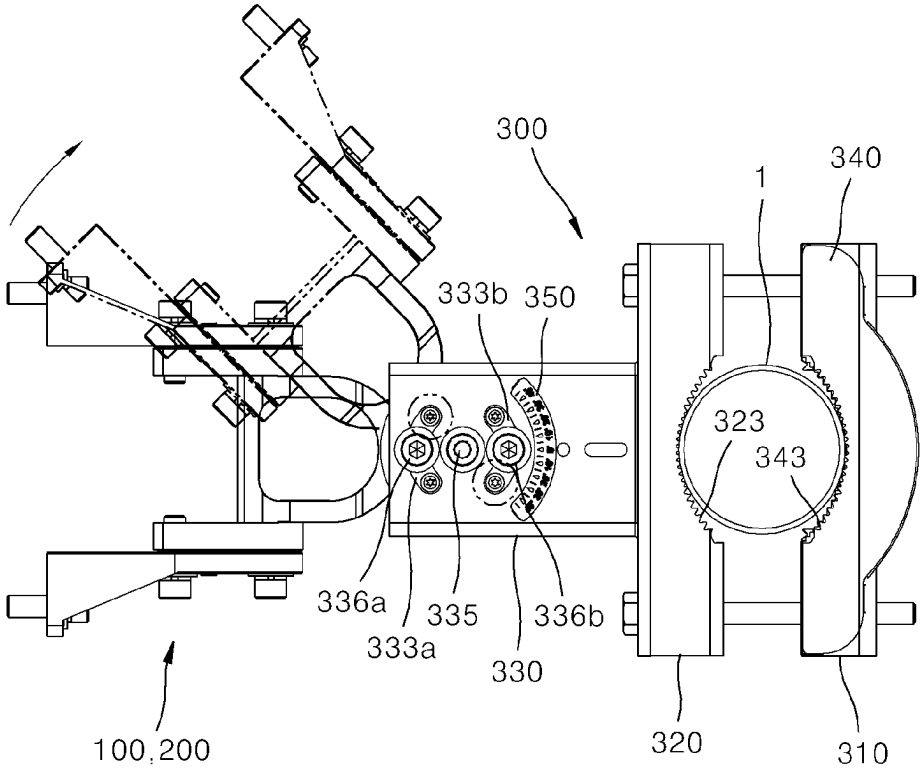

300
1
340
333b
350
323
343
336a
335
336b
333a
330
100,200
320
310

FIG. 8

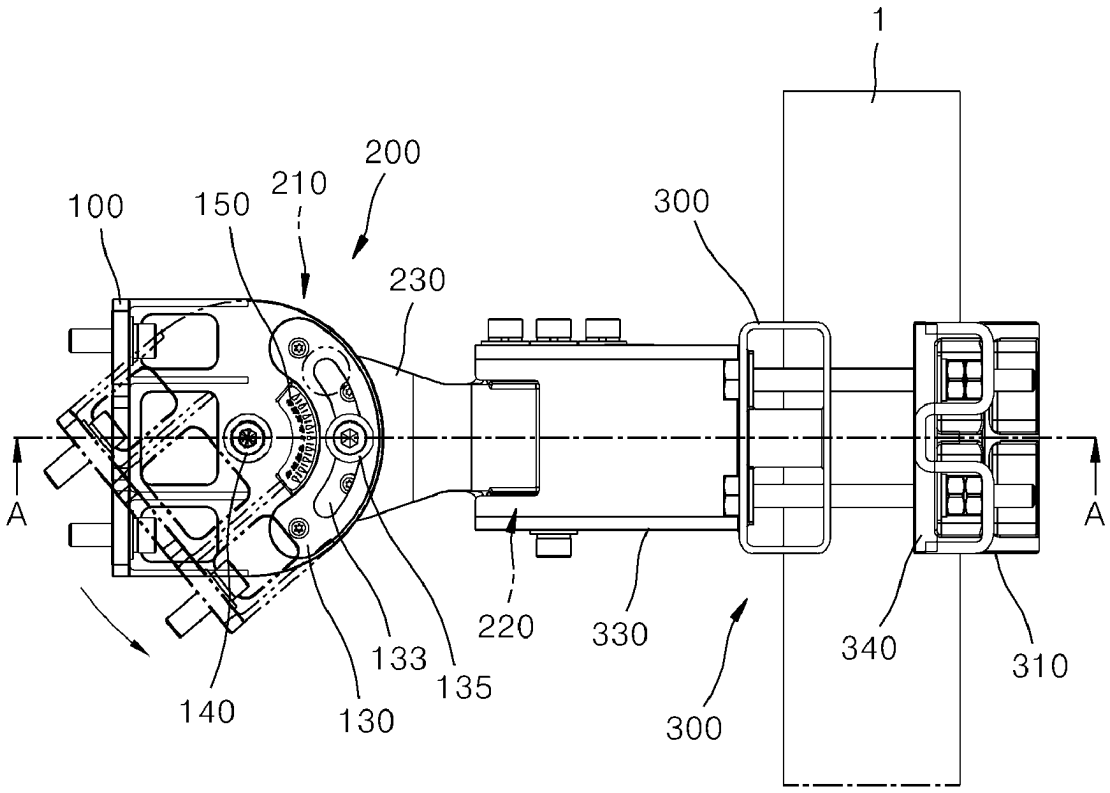


FIG. 9

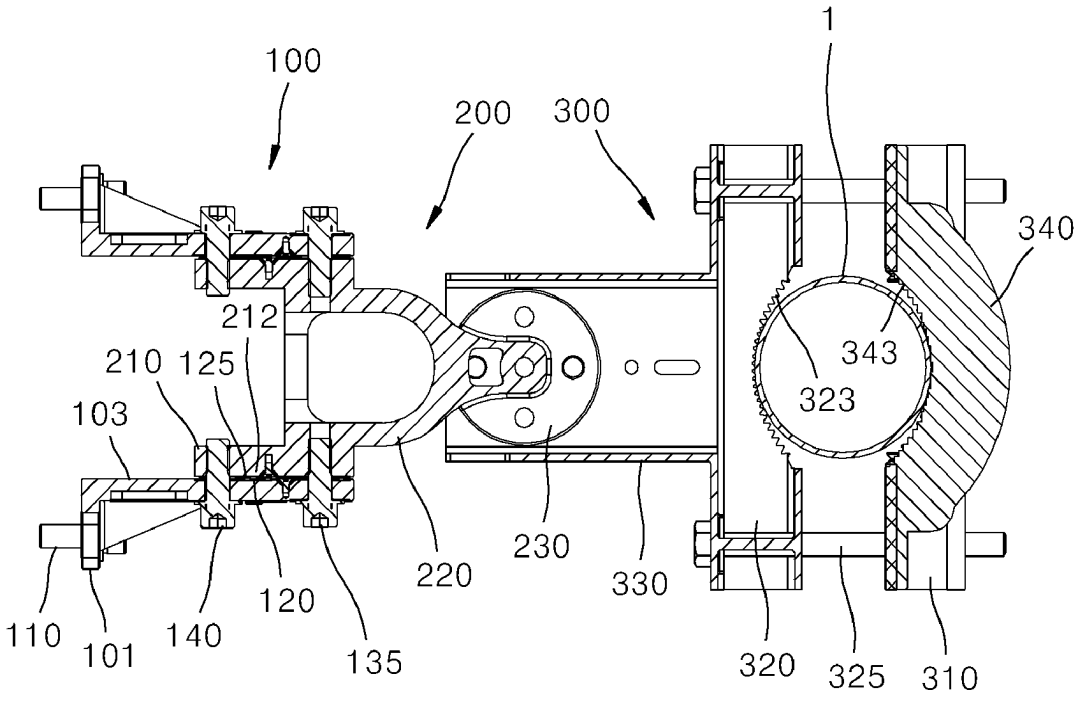

1
100
200
300
340
212
210
125
103
343
323
110
101
140
120
135
220
230
330
320
325
310

FIG. 10

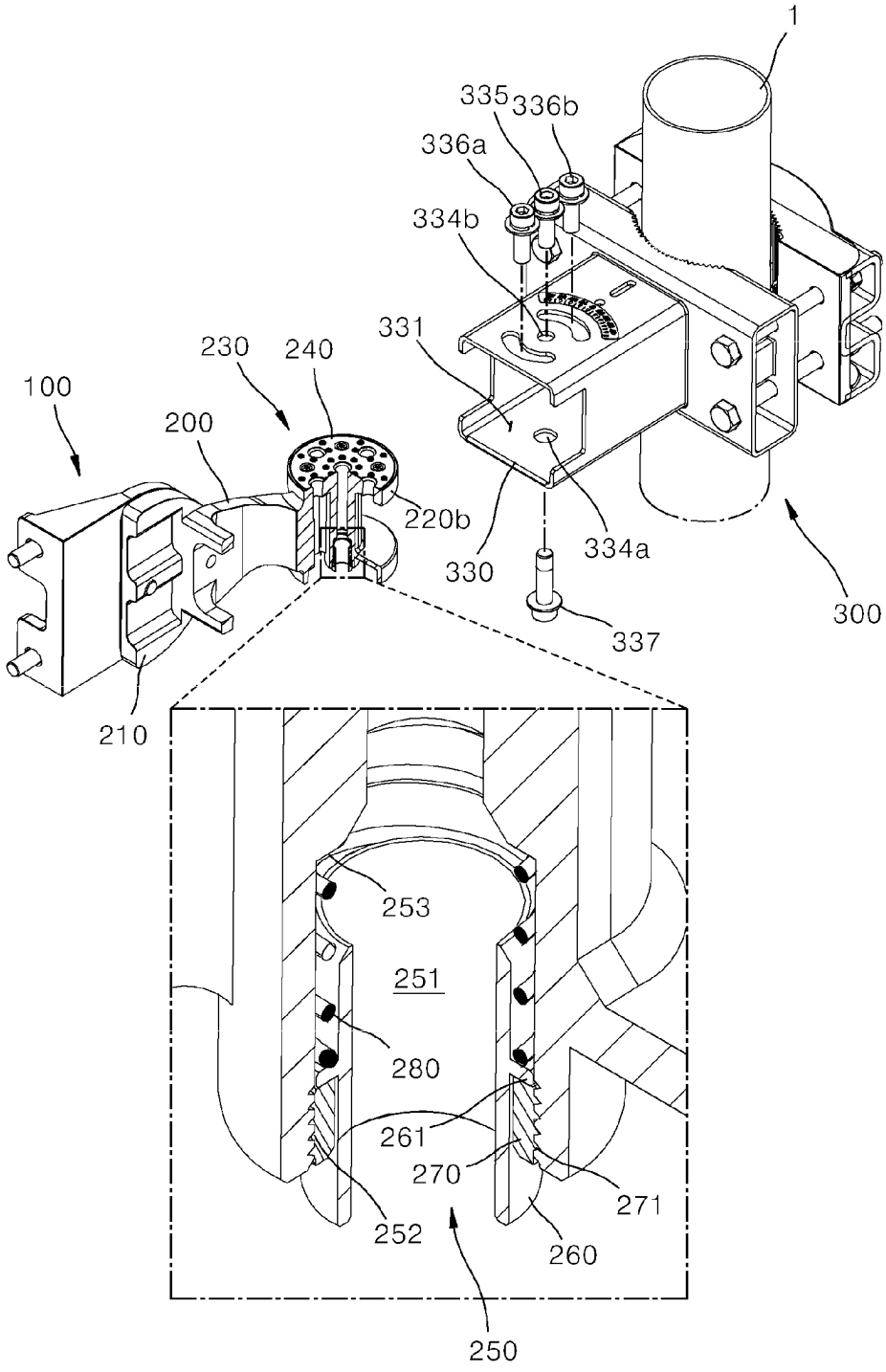

1
335
336b
336a
334b
331
230
240
100
200
220b
330
334a
300
337
210
253
251
280
261
270
271
252
260
250

FIG. 11A

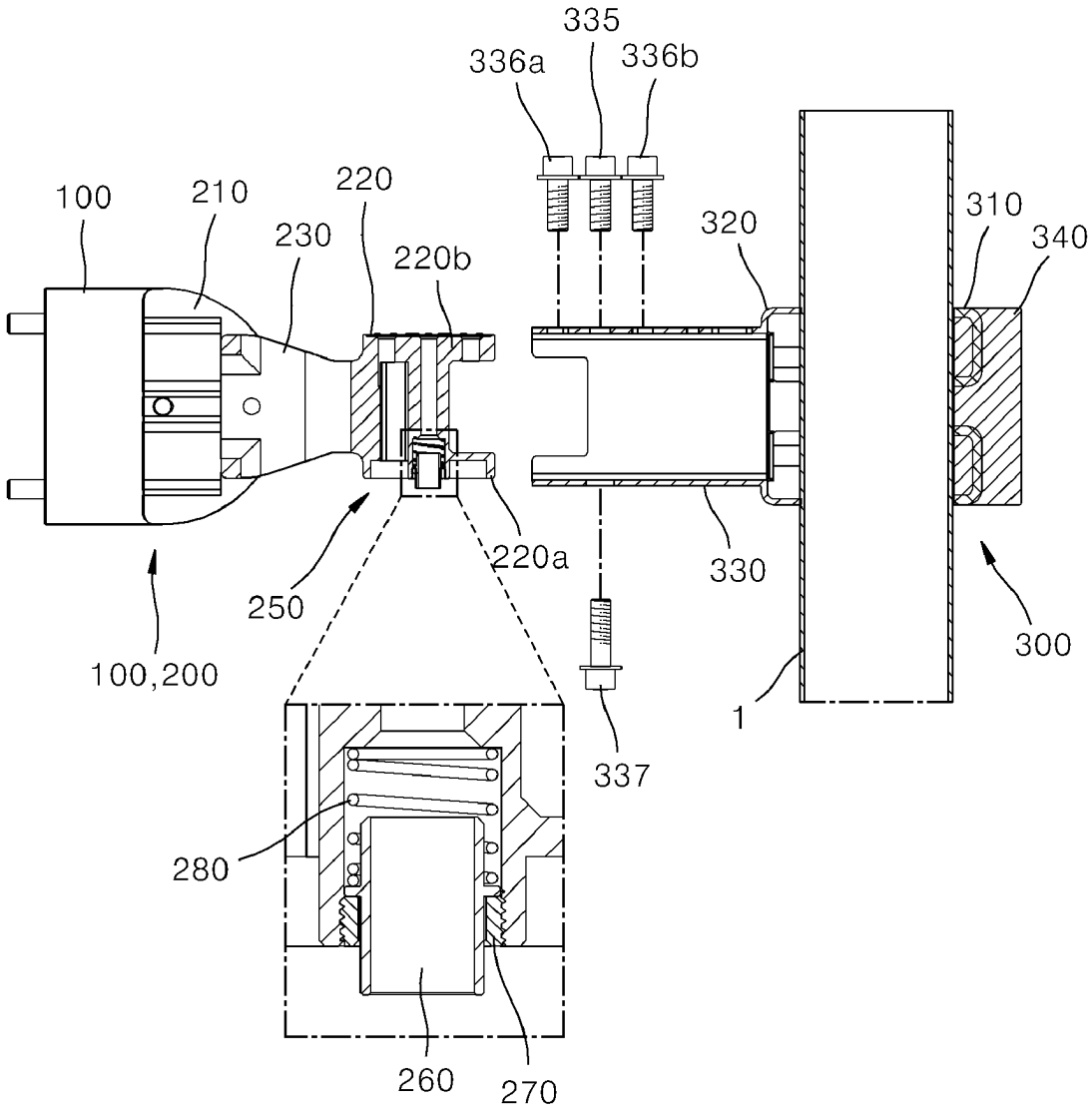

335
336a
336b
100
210
220
230
220b
320
310
340
250
220a
330
100,200
300
1
337
280
260
270

FIG. 11B

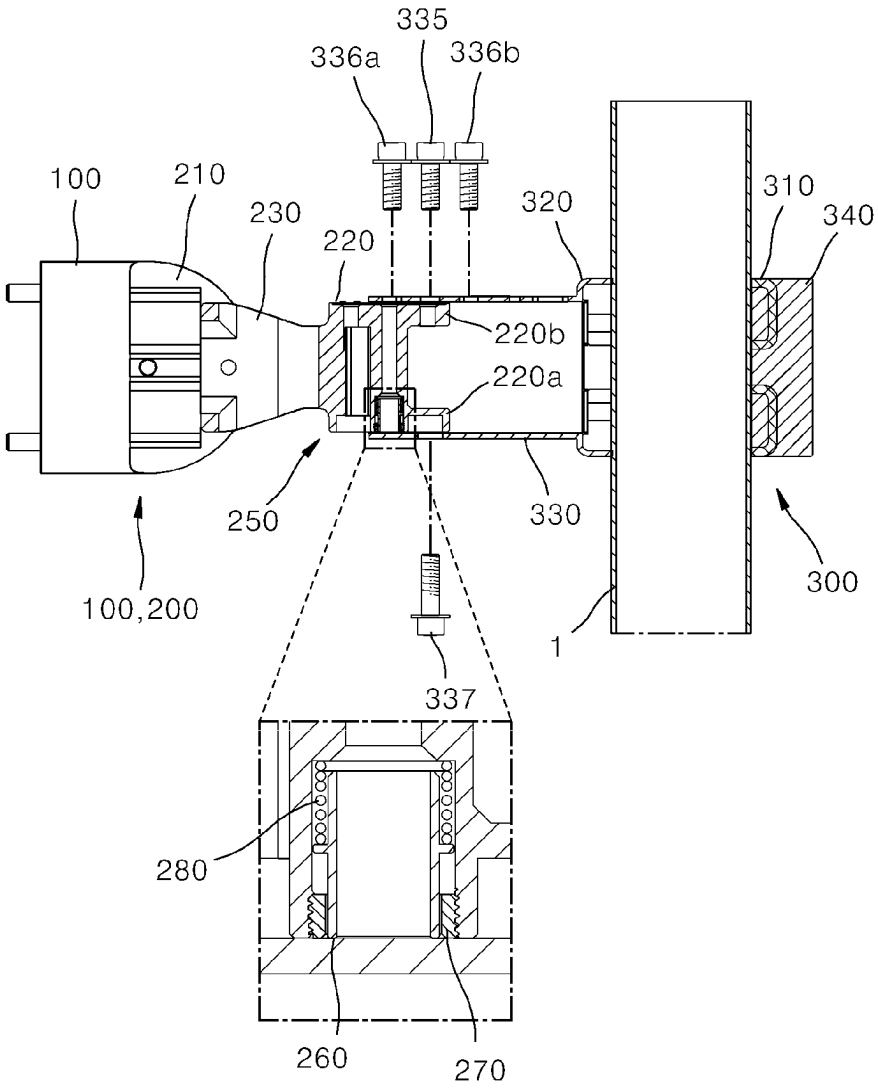

335
336a
336b
100
210
230
220
320
310
340
220b
220a
250
330
100,200
300
1
337
280
260
270

FIG. 11C

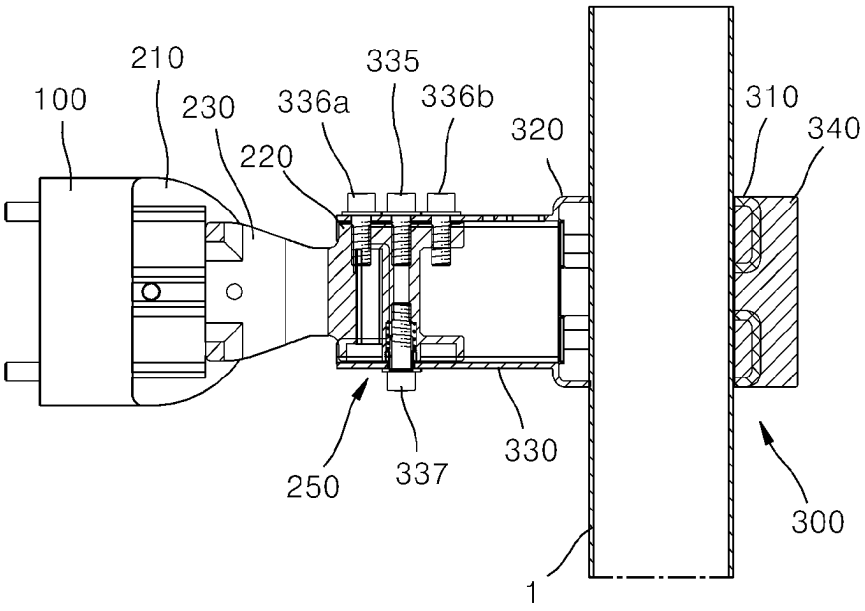


FIG. 12

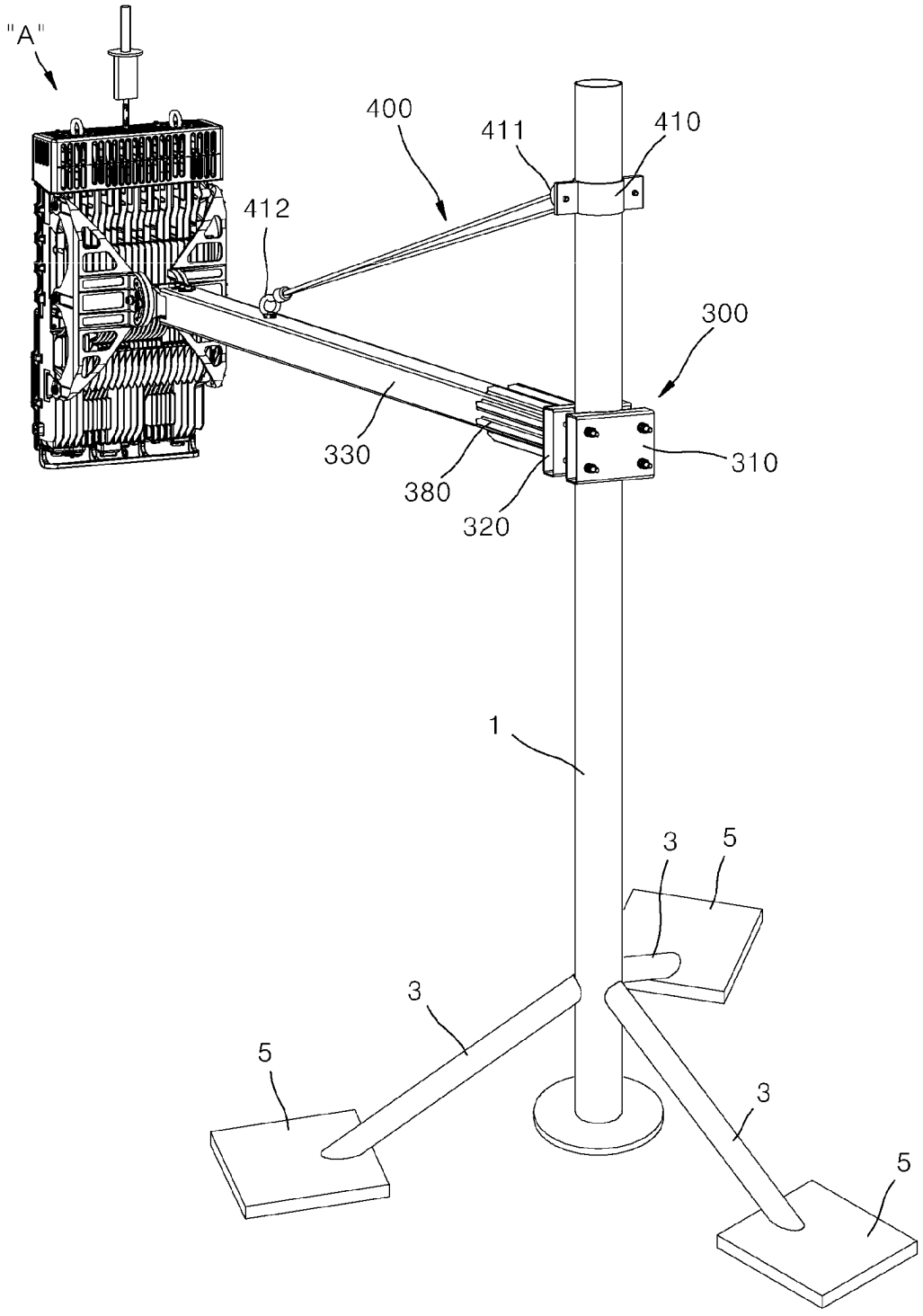


FIG. 13

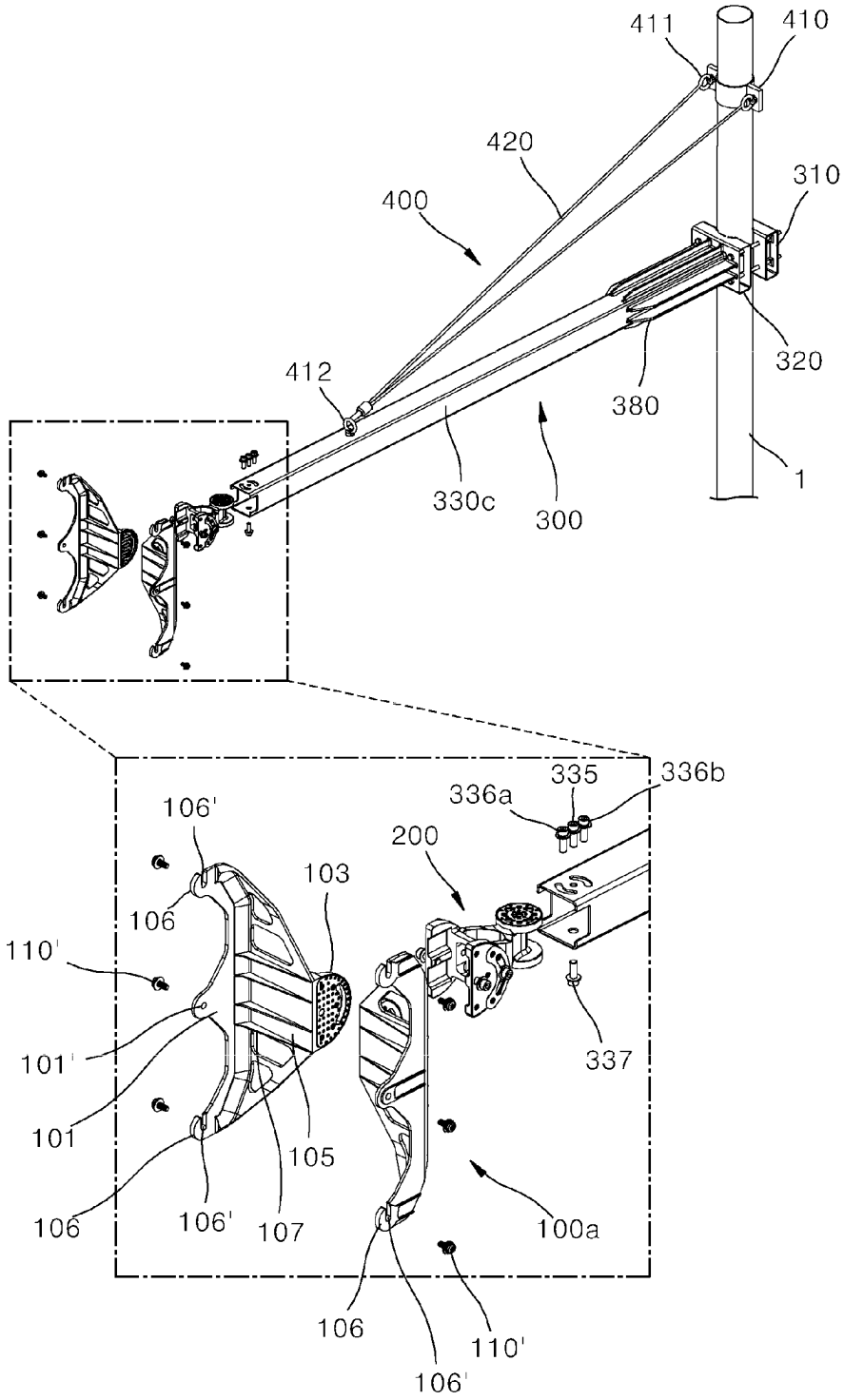

411
410
420
400
310
320
412
380
330c
300
1
335
336b
336a
106'
200
103
106
110'
101'
101
337
105
106
106'
107
100a
106
110'
106'

FIG. 14A

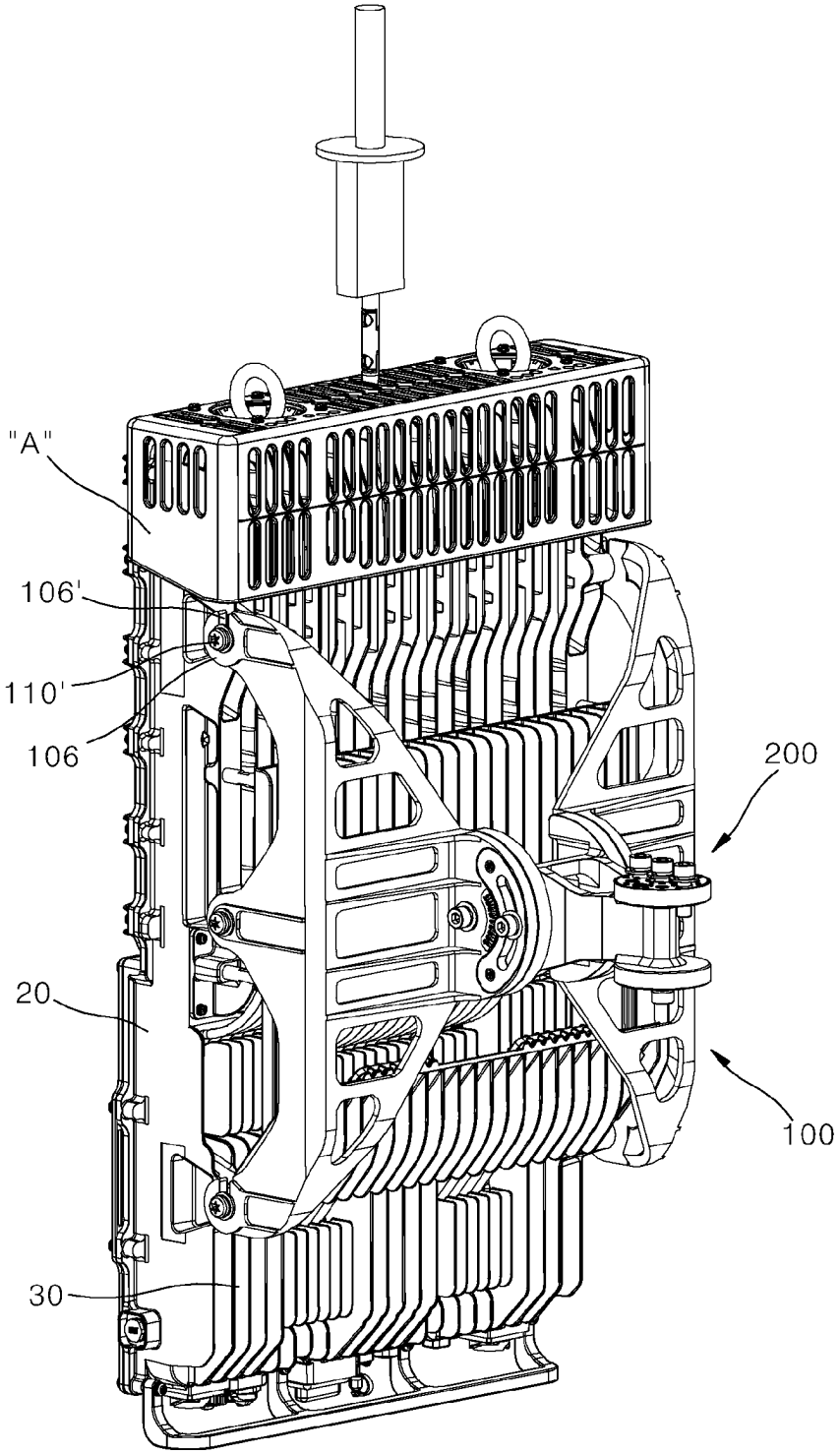


FIG. 14B

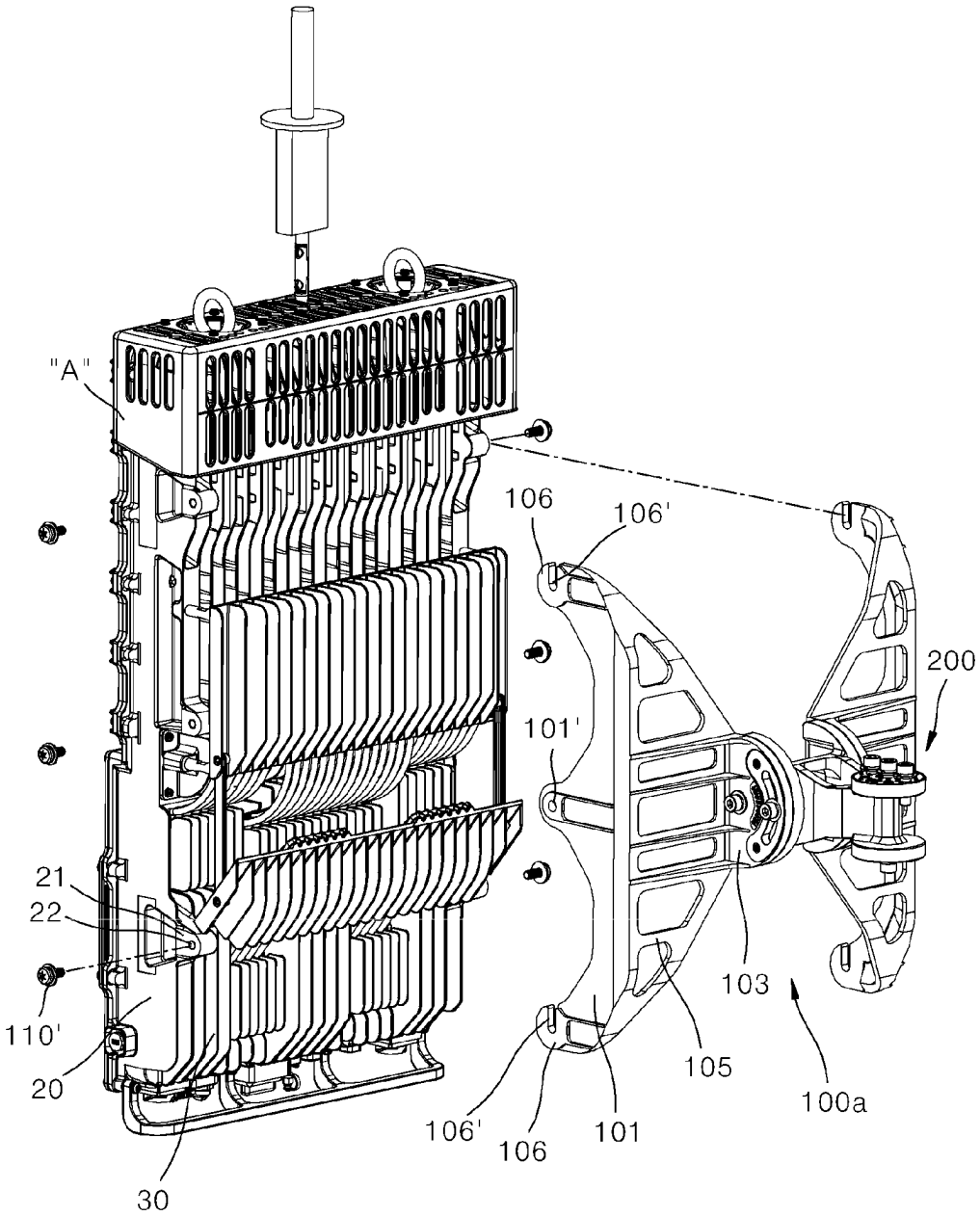
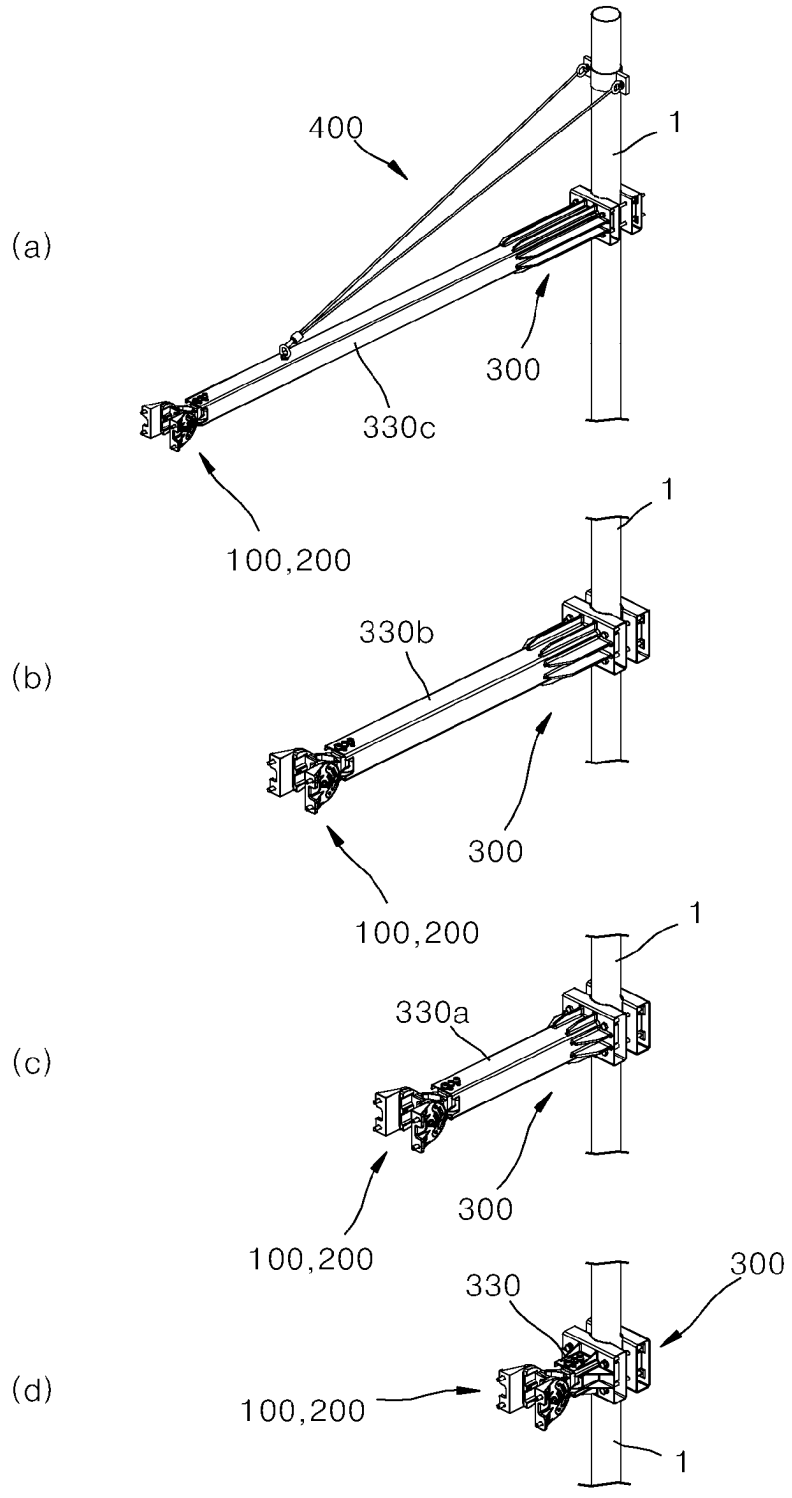


FIG. 15


(a)
400
1
300
330c
100,200
(b)
1
330b
300
100,200
(c)
1
330a
300
100,200
(d)
330
300
100,200
1

CLAMPING APPARATUS FOR ANTENNA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 17/474,072, filed on Sep. 14, 2021 (now U.S. Pat. No. 11,909,094), which is a continuation application of International Application No. PCT/KR2020/003723, filed Mar. 18, 2020, which claims the benefit of Korean Patent Application Nos. 10-2019-0030768, filed Mar. 18, 2019, and 10-2019-0136082, filed Oct. 30, 2019, in the Korean Intellectual Property Office, the disclosures of which are incorporated herein in their entirety by reference.

TECHNICAL FIELD

The present disclosure relates to a clamping apparatus for an antenna, and more particularly, to a clamping apparatus for an antenna, in which an antenna device can be efficiently disposed in a compact installation space as well as a direction of the antenna device is easily adjusted.

BACKGROUND ART

Wireless communication technology, for example, multiple-input multiple-output (MIMO) technology is technology that remarkably increases a data transmission capacity using multiplexing technique for transmitting different data multiple antennas, and is a spatial through each transmitting antenna at a transmitter and for sorting the transmitted data through adequate signal processing at a receiver.

Therefore, by simultaneously increasing the number of transmitting antennas and the number of receiving antennas, a channel capacity is increased, and more data can be transmitted. For example, if the number of antennas is increased to ten, a channel capacity of about ten times is secured using the same frequency band compared to a current single antenna system.

In 4G LTE-Advanced, antennas are used up to eight, and products in which 64 or 128 antennas are mounted in a pre-5G step are developed at present. It is expected that base station equipment having far more antennas will be used in 5G, which is referred to as Massive MIMO technology. A current cell operation is of two dimensions, whereas, if the Massive MIMO technology is introduced, 3D-Beamforming is possible, thus being also referred to as full dimension (FD)-MIMO.

In the Massive MIMO technology, as the number of antennas (ANTs) increases, the number of transmitters and the number of filters are increased together. However, due to lease expenses of an installation space or spatial limitations, RF elements (antenna/filter/power amplifier/transceiver, etc.) are actually made small, light, and inexpensive. Massive MIMO requires a high output for coverage expansion, and power consumption and a heating value caused by the high output act as negative factors in reducing weight and a size.

Especially, when a MIMO antenna, in which modules implemented by RF elements and digital elements are coupled in a layered structure, is installed in a restricted space, the necessity for compact and miniature design of a plurality of layers constituting the MIMO antenna in order to maximize installation easiness or spatial applicability is rising, and the necessity for free direction adjustment of an antenna device installed on one support pole is strongly requested.

DISCLOSURE

Technical Problem

An object of the present disclosure is to provide a clamping apparatus for an antenna which can increase a degree of freedom of installation with respect to a support pole having many spatial limitations and improve workability.

Technical objects of the present disclosure are not limited to the aforementioned technical object, and other technical objects not described above may be evidently understood by those skilled in the art from the following description.

Technical Solution

An embodiment of a clamping apparatus for an antenna according to the present disclosure includes: an arm unit that is coupled to a support pole and has a mounting space formed in a tip portion thereof so as to open in a longitudinal direction; a rotation unit that is detachably mounted in the mounting space of the arm unit and has a tip portion coupled to be rotatable about a hinge point in the mounting space at a predetermined angle in a left-right direction; a tilting unit that is coupled to the tip portion of the rotation unit so as to be tiltable in an up-down direction and configured to mediate coupling of an antenna device; and a mounting guide unit that is provided to the rotation unit, and is elastically pressed, and then is temporarily fixed to the hinge point in the mounting space when the rotation unit is mounted in the mounting space of the arm unit.

Here, the mounting guide unit may include a guide tube that is provided such that an outer end thereof is protrudable outward from a lower hinge fastening hole, which is provided such that a part of the rotation unit which corresponds to the hinge point in the mounting space is recessed, at a predetermined length; and an elastic body that elastically supports the guide tube in an outward direction of the rotation unit.

Moreover, an outer end of the guide tube may protrude at a length at which the guide tube is inserted into and caught in a hinge hole formed at the hinge point in the mounting space of the arm unit

Moreover, a lower rotating pin may pass through the hinge point at an outer side of the arm unit and be inserted into and installed in the guide tube.

Moreover, the mounting guide unit may further include an anti-separation nut that is screwed to an inner circumferential surface of the lower hinge fastening hole so as to prevent outward separation of the guide tube.

Moreover, the anti-separation nut may be located between an outer circumferential surface of the guide tube and the inner circumferential surface of the lower hinge fastening hole, and a hanging rib hung on the anti-separation nut may be formed on the outer circumferential surface of the guide tube so as to extend outward in a circumferential direction.

Moreover, the arm unit may include: an outer mounting block that is disposed to come into close contact with one side of an outer circumferential surface of the support pole; an inner mounting block that is disposed to come into close contact with the other side **4** the outer circumferential surface of the support pole and is fixed with the outer mounting block by at least one or more fixing bolts; and a clamp arm that extends from the inner mounting block at a predetermined length in a direction orthogonal to the support pole and constitutes a tip portion to which the mounting space is provided.

Moreover, at least one or more reinforcement ribs may be formed at a connection part between the inner mounting block and the clamp arm.

Moreover, the clamp arm may be manufactured at multiple preset lengths so as to be installable in a different separation distance from the support pole depending on another antenna device, which is installed adjacent to the antenna device coupled to the tilting units, and surrounding interference bodies.

Moreover, the clamping apparatus for an antenna may further include a reinforcement wire unit having connecting wire, one end of which is fixed to a part of the support pole which corresponds to an upper portion of the arm unit, and the other end of which is fixed to the clamp arm of the arm unit.

Moreover, the reinforcement wire unit may be selectively installed in consideration of fatigue strength of a connection part between the inner mounting block and the clamp arm depending on weight of the antenna device coupled to the tilting unit and a length of the clamp arm.

Moreover, at least one rotation guide part may be formed at a tip portion of the clamp arm, to which the mounting space is provided, in a slot hole shape so as to guide a rotating motion of the rotation unit.

Moreover, the rotation guide part may include: at least one rotation guide slot that is formed in a circumference having a common center with the hinge point; and a rotation guide bolt that passes through the at least one rotation guide slot from an outside and is fixed to the rotation unit.

Moreover, a rotating angle label, which indicates a position of the rotation guide bolt moved in the rotation guide slot from a reference point at an angle, may be attached to the tip portion of the clamp arm.

Moreover, the rotation unit may include: tilting unit installing stages to which the tilting unit is tiltably coupled; a rotating block that is inserted into the mounting space of the arm unit; and a connecting block that interconnects the tilting unit installing stages and the rotating block.

Moreover, a rotating braking washer pad may be interposed between the rotating block and the arm unit, and tilting braking washer pads may be interposed between the tilting unit installing stages and the tilting unit.

Moreover, a rotating braking washer pad mounting recess, to which the rotating braking washer pad is coupled in a corresponding shape, may be formed in an upper surface of the rotating block, and tilting braking washer pad mounting recesses, to which the tilting braking washer pads are coupled in a corresponding shape, may be formed in inner lateral surfaces of the tilting unit installing stages.

Moreover, a plurality of braking protrusions may be formed to protrude from an upper surface of the rotating braking washer pad and inner lateral surfaces of the tilting braking washer pads.

Moreover, the tilting unit installing stages may be provided apart from each other in a pair so as to extend from left and right ends of the connecting block toward the tilting unit, and tilting pins becoming a tilting center of the tilting unit may be provided in outer lateral surfaces of the tilting unit installing stages so as to be connected with the tilting unit.

Moreover, the tilting unit may include: antenna coupling stages that are coupled with the antenna device; and tilting blocks that are coupled to come into surface contact with one outer lateral surface and the other outer lateral surface of the rotation unit, and tilting guides may be formed in a slot hole shape and be attached to the tilting blocks so as to guide a tilting motion of the tilting unit.

Moreover, the tilting blocks may be tilted about tilting pins that are provided to outer lateral surfaces of tilting unit installing stages of the rotation unit so as to become a tilting center of the tilting unit, and the tilting guides may include: tilting guide slots that are formed on circumferences having common centers with the tilting pins; and tilting guide bolts that pass through the tilting guide slots from an outside and are fixed to the rotation unit.

Moreover, a tilting angle label, which indicates a position of each of the tilting guide bolts moved in each of the tilting guide slots from a reference point at an angle, may be attached to an outer lateral surface of each of the tilting blocks.

Moreover, the tilting unit may further include an expansion connector that is expanded to connect the antenna coupling stage and the tilting block in a left-right direction.

Moreover, each of the antenna coupling stages may come into surface contact with a plurality of places of any one of a rear surface and a lateral surface of the antenna device, and be fastened and fixed to fastening holes formed in the plurality of places of any one of the rear surface and the lateral surface of the antenna device via fastening means.

Moreover, each of the antenna coupling stages may have at least two or more fastening flanges, in each of which a U-shaped fastening hole having an open upper side is formed, such that fixing screws, which are previously fastened to a plurality of places of a lateral surface of the antenna device in a temporarily fixed form, are hung downward and then screwed.

Moreover, the support pole may include: multiple support rods that slantly extend downward from an outer circumferential surface of the support pole and are radially spaced apart from one another at a predetermined angle; and supporting panels that are provided at tips of the multiple support rods and are supported and coupled to a ground or a wall.

Advantageous Effects

An embodiment of the clamping apparatus for an antenna according to the present disclosure can achieve the following various effects.

First, an arm unit is manufactured in various lengths and is installed, and thereby spatial layout design of multiple antenna devices installed on one support pole is easy.

Second, tilting and rotating motions of the antenna device are facilitated through a tilting unit and a rotation unit, and thus workability and frequency yield performance of the antenna device can be improved.

DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view illustrating an example of a state in which an antenna device is installed in an embodiment of a clamping apparatus for an antenna according to the present disclosure.

FIG. **2** is a perspective view illustrating an embodiment of a clamping apparatus for an antenna according to the present disclosure.

FIG. **3** is an exploded perspective view illustrating the clamping apparatus of FIG. **2**.

FIG. **4** is an exploded perspective view illustrating a tilting unit among the components of FIG. **2**.

FIG. **5** is an exploded perspective view illustrating a rotation unit among the components of FIG. **2**.

FIG. **6** is an exploded perspective view illustrating an arm unit among the components of FIG. **2**.

FIG. **7** is a top view of FIG. **2** which illustrates a rotating motion caused by the rotation unit.

FIG. **8** is a side view of FIG. **2** which illustrates a tilting motion caused by the tilting unit.

FIG. **9** is a sectional view taken along line A-A of FIG. **8**.

FIG. **10** is a cutaway perspective view and an enlarged view illustrating the mounting guide unit among the components of FIG. **2**.

FIGS. **11**A to **11**C are side sectional views illustrating an operating state of the mounting guide unit of FIG. **10**

FIG. **12** is a perspective view illustrating an example of an installed state of the antenna device, as a modification of the arm unit and the tilting unit among the components of an embodiment of the clamping apparatus for an antenna according to the present disclosure.

FIG. **13** is an exploded perspective view of FIG. **12**.

FIGS. **14**A and **14**B are a perspective view and an exploded perspective view illustrating a state in which the antenna device is installed on the tilting unit of FIG. **12**.

FIG. **15** is a perspective view illustrating various embodiments of the arm unit among the components of FIG. **2**.

DESCRIPTION OF REFERENCE NUMERALS

1: support pole
3: multiple support rods
5: supporting panel
50: clamping apparatus for antenna
100: tilting unit
101: antenna coupling stage
102: guide slot mounting recess
103: tilting block
104: tilting braking washer pad mounting recess
107: reinforcement rib
108: fixing hole
109: tilting through-slot
110: fastening bolt
120: tilting braking washer pad
121: fastening hole
122: fastening screw
123: washer through-slot
125: braking protrusion
127: rotating pin through-hole
130: tilting guide
131: fastening hole
132: fastening screw
133: tilting guide slot
140: tilting pin
150: tilting angle label
200: rotation unit
210: tilting unit installing stage
211: pad installation recess
212: friction pad
213: friction pad installing hole
214: friction pad through-hole
215: flat head screw
217: rotating pin fastening hole
220: rotating block
220*a*: lower block
220*b*: upper block
220*c*: center block
221: rotating braking washer pad mounting recess
222*a*: upper hinge fastening hole
222*b*: front guide bolt fastening hole
222*c*: rear guide bolt fastening hole
225: fixing hole
230: connecting block
240: rotating braking washer pad
241: braking protrusion
250: mounting guide unit
251: lower hinge fastening hole
252: internal thread
260: guide tube
261: hanging rib
270: anti-separation nut
271: external thread
280: elastic body
300: arm unit
310: outer mounting block
311: outer bolt through-hole
313: nut fastening part
320: inner mounting block
323: inner shape-fitting recess
325: fixing bolt
330: clamp arm
331: mounting space
333*a*: front guide slot
333*b*: rear guide slot
334*a*: lower hinge hole
334*b*: upper hinge hole
335: upper rotating pin
336*a*: front rotation guide bolt
336*b*: rear rotation guide bolt
337: lower rotating pin
340: support block
341: support bolt through-hole
343: outer shape-fitting recess
350: rotating angle label
360: fastening nut
400: reinforcement wire unit

Best Mode

Hereinafter, an embodiment of a clamping apparatus for an antenna according to the present disclosure will be described in detail with reference to the accompanying drawings. In adding reference numerals to the elements of each drawing, it should be noted that the same elements have the same reference numerals as much as possible even if they are displayed in different drawings. Moreover, in describing embodiments of the present disclosure, when it is determined that a detailed description of the related well-known configuration or function hinders understanding of an embodiment of the present disclosure, the detailed description thereof will be omitted.

Furthermore, in describing elements of an embodiment of the present disclosure, terms, such as a first, a second, A, B, (a), and (b), may be used. Such terms are used only to distinguish one component from the other component, and the essence, order, or sequence of a corresponding component is not limited by the terms. All terms used herein, including technical or scientific terms, have the same meanings as those commonly understood by a person having ordinary knowledge in the art to which the present disclosure pertains, unless defined otherwise in the specification. Terms, such as those commonly used and defined in dictionaries, should be construed as having the same meanings as those in the context of a related technology, and are not construed as being ideal or excessively formal unless explicitly defined otherwise in the specification.

FIG. **1** is a perspective view illustrating an example of a state in which an antenna device is installed in an embodiment of a clamping apparatus for an antenna according to the present disclosure. FIG. **2** is a perspective view illustrating

an embodiment of a clamping apparatus for an antenna according to the present disclosure. FIG. **3** is an exploded perspective view illustrating the clamping apparatus of FIG. **2**. FIG. **4** is an exploded perspective view illustrating a tilting unit among the components of FIG. **2**. FIG. **5** is an exploded perspective view illustrating a rotation unit among the components of FIG. **2**. FIG. **6** is an exploded perspective view illustrating an arm unit among the components of FIG. **2**

Referring to FIGS. **1** to **6**, an embodiment of a clamping apparatus **50** for an antenna according to the present disclosure includes an arm unit **300** that is horizontally coupled to a support pole **1** that is fixed to the ground in a vertical direction, a rotation unit **200** that is coupled with the arm unit **300** and is coupled to be rotatable about the arm unit **300** in a left-right direction, and a tilting unit **100** that is coupled to the rotation unit **200** and is coupled to be tiltable in an up-down direction while mediating coupling of an antenna device A.

Referring to FIG. **1**, the support pole **1** in an embodiment of the present disclosure is implemented by being fixed to the ground via multiple support rods **3** and multiple supporting panels **5** in a vertical direction, and is implemented in such a manner that the arm unit **300** is horizontally coupled with the support pole so as to be perpendicular to the support pole.

However, the support pole **1** is not necessarily provided to the ground in a vertical direction, and may be naturally coupled to a vertical wall of a building via the multiple support rods **3** and the multiple supporting panels **5**. In this case, the support pole **1** is provided horizontally, and the arm unit **300** is perpendicular to the support pole **1**. However, various embodiments in which the support pole **1** and the arm unit **300** are actually provided horizontally or vertically can be expected.

Hereinafter, the description is made on the assumption that, referring to FIG. **1**, to enable a direction and its relevant term to be identical to each other, the support pole **1** is fixed to the ground of a horizontal state via the multiple support rods **3** and the multiple supporting panels **5** in a vertical direction, and the description is made within the limits of the case in which the arm unit **300** extends in a horizontal direction orthogonal to the support pole **1**. However, it is made clear in advance that an embodiment of the present disclosure does not necessarily limit these directions.

The arm unit **300** serves to mediate coupling of the antenna device A to the support pole **1**. It can be understood that, as another meaning, the arm unit **300** serves to mediate coupling of the clamping apparatus **50** for an antenna, to which the antenna device A is coupled, to the support pole **1**.

The antenna device A coupled by the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure may be the antenna device A to which the Massive MIMO technology or the FD-MIMO technology in which the 3D-Beamforming is possible, which is introduced in the "Background Art" described previously, is applied.

This arm unit **300** may be formed in such a form that it is substantially coupled to one side and the other side of an outer circumferential surface of the support pole **1** by bolting and that it extends at a predetermined length in a direction perpendicular to a lengthwise direction of the support pole **1** and the antenna device A is installed spaced apart from the support pole **1** by a predetermined length.

The rotation unit **200** may be coupled to a tip portion of the arm unit **300** so as to be rotatable in a left-right direction. The rotation unit **200** is rotated about the tip portion of the arm unit **300** in a left-right direction, thereby serving to substantially facilitate directivity design of the left-right direction of the antenna device A coupled to the tilting unit **100**.

Moreover, the tilting unit **100** is coupled to a tip portion of the rotation unit **200** so as to be tiltable in an up-down direction. The tilting unit **100** is tilted about the tip portion of the rotation unit **200** in an up-down direction, thereby serving to substantially facilitate directivity design of the up-down direction of the antenna device A coupled to the tilting unit **100**.

In this way, an embodiment of the clamping apparatus **50** for an antenna according to the present disclosure enables angle fixation with respect to a radiation direction of radio waves radiated from a front surface of the antenna device A coupled to the support pole **1** by rotating the antenna device A in a left-right direction using the rotation unit **200**, as well as by tilting the antenna device A in an up-down direction using the tilting unit **100**. A state of the angle fixation caused by the rotation unit **200** and the tilting unit **100** will be described below in greater detail.

Hereinafter, for the convenience of understanding, the description will be made by defining a front direction of the antenna device A as "front", defining the opposite direction as "rear", defining a left side of the front as "leftward direction" and a right side of the front as "rightward direction", and defining an upper side of the antenna device A as "upward direction" and a lower side of the antenna device A as "downward direction".

Hereinafter, the description will be made in greater detail from an adjacent component centering on the antenna device A.

Referring to FIGS. **1** to **6**, the antenna device A is coupled to a tip portion of the tilting unit **100**. More specifically, the antenna device A is coupled to the tip portion of the rotation unit **200** such that the tilting unit **100** is tiltable in a state coupled to the tip portion of the tilting unit **100**. In this state, referring to FIG. **3**, the rotation unit **200** is mounted in a mounting space **331** that is provided at the tip portion of the arm unit **300** fixed to the support pole **1**, whereby, referring to FIG. **2**, the installation of the antenna device A based on an embodiment of the clamping apparatus **50** for an antenna according to the present disclosure can be completed.

Here, referring to FIG. **4**, the tilting unit **100** may include antenna coupling stages **101** that are coupled with the antenna device A, and tilting blocks **103**, each of which extends to the rear where the rotation unit **200** is provided and is coupled to come into surface contact with one outer lateral surface or the other outer lateral surface of the rotation unit **200**.

Each of the antenna coupling stages **101** is a part that comes into close contact with a rear surface of the antenna device A and has bolt through-holes **110***a* formed to be able to be bolted by fastening bolts **110**. Referring to FIG. **4**, two bolt through-holes **110***a* may be formed spaced apart from each other up and down by a predetermined distance.

Referring to FIG. **4**, each of the tilting blocks **103** is a part that has a surface orthogonal to a coupling surface of each of the antenna coupling stages **101** and is substantially coupled to a left or right lateral surface of the tip portion of the rotation unit **200**.

Multiple reinforcement ribs **107** are provided between each of the tilting blocks s **103** and each of the antenna coupling stages **101**, and can improve durability by reinforcing a mechanical fatigue caused by weight of the antenna device A or wind around the antenna device A.

Each of the tilting blocks **103** may be configured such that a tilting guide **130**, which is formed in a slotted plate shape so as to guide the tilting motion of the tilting unit **100**, is attached to an outer lateral surface thereof opposite to an inner lateral surface thereof which comes into close contact with the left or right lateral surface of the tip portion of the rotation unit **200**. In addition, each of the tilting blocks **103** may be configured such that a tilting pin **140** is provided to the inner surface thereof which comes into close contact with the left or right lateral surface of the tip portion of the rotation unit **200** so as to become a tilting center of the tilting unit **100**.

Each of the tilting guides **130** may include a tilting guide slot **133** that is formed in the same circumference thereof centering on the tilting pin **140**, and a tilting guide bolt **135** that passes through the tilting guide slot **133** from the outside and is fixed to the rotation unit **200**.

Each of the tilting guides **130** may be provided in a plate shape corresponding to a shape of a guide slot mounting recess **102** that is formed to be recessed in the same depth toward an inner lateral surface from an outer lateral surface of the tilting block **103**, and the tilting guide slot **133** may be formed to pass through the tilting guide **130** in a left-right direction. Fixing holes **102'**, to which fastening screws **132** provided in the form of a flat head screw are fastened to pass through fastening holes **131** formed in the tilting guide **130**, may be formed in the guide slot mounting recess **102**.

Here, the tilting guide slot **133** formed in the tilting guide **130** is formed in the same circumference having a common center with the tilting pin **140**, and may be formed to have a circumferential surface on which the tilting unit **100** is tiltable upward and downward on the basis of the horizon at a maximum angle of 40 degrees.

Referring to FIG. **3**, a tilting angle label **150**, which indicates a position of the tilting guide bolt **135** moving in the tilting guide slot **133** from a reference point at an angle, may be attached to a part of an outer lateral surface of the tilting block **103** which corresponds to one side of the tilting guide **130**.

Here, the reference point for the position of the tilting guide bolt **135** refers to a horizontal state in which no tilting motion of the tilting block **103** is performed and is indicated by "0 degree", and the tilting angle may be indicated with respect to each of upward tilting and downward tilting at angular intervals of 5° or 10°. Therefore, an installation worker mounts the antenna device A on the tilting unit **100**, and then fixes the tilting unit **100** by tilting the tilting unit **100** at an accurate position through the tilting angle label **150**, whereby reliability of installation work of the antenna device A can be improved.

The tilting pin **140** is a kind of bolt that is installed to pass through the tilting block **103** from an outside to an inside of the tilting block **103**, is fixed to the outer lateral surface of the rotation unit **200** like a hinge, and becomes a tilting center of the tilting unit **100**.

The tilting unit **100** may be provided in a pair so as to be coupled to tilting unit installing stages **210** provided left and right in a pair among the components of the rotation unit **200**. Therefore, the description is made on the assumption that components of the tilting unit **100** described above and components of the tilting unit **100** to be described below are provided in bilateral symmetry in a pair unless defined otherwise.

Meanwhile, tilting braking washer pads **120** may be interposed between inner lateral surfaces of the tilting blocks **103** and outer lateral surfaces of the rotation unit **200** (preferably, outer lateral surfaces of the tilting unit installing stages **210**). Each of the tilting braking washer pads **120** may be fastened to a tilting braking washer pad mounting recess **104** recessed in the inner lateral surface of the tilting block **103** so as to correspond to a shape of the tilting braking washer pad mounting recess **104** by a process of fastening screws **122** provided in the form of a flat head screw passing through and being fastened to fastening holes **121** formed across left and right and fixing holes **108** formed in the inner lateral surface of the tilting block **103**.

A plurality of braking protrusions **125** are formed on an inner lateral surface of each of the tilting braking washer pads **120** so as to protrude inward, thereby serving to prevent the antenna device A from being arbitrarily tilted by weight of the antenna device A and an external force such as a wind blowing around the antenna device A by forming a predetermined friction force between the inner lateral surface of the tilting braking washer pad **120** and the outer lateral surface of the rotation unit **200** during the tilting motion of the tilting unit **100**. As will be described below, friction pads **212** are installed on the outer lateral surfaces of the tilting unit installing stages **210** of the rotation unit **200**, thereby forming a mutual friction force with the tilting braking washer pads **120**.

A washer through-slot **123**, through and to which the tilting guide bolt **135** can pass and be fastened, may be formed in each of the tilting braking washer pads **120** in a shape corresponding to the tilting guide slot **133**. In addition, tilting a through-slot **109** having a shape corresponding to the tilting guide slot **133** may be formed in the tilting block **103**. The tilting guide bolt **135** is a bolt that is fixedly fastened to the left or right lateral surface of the tip portion of the rotation unit **200**, and may pass through the tilting guide slot **133**, the tilting through-slot **109**, and the washer through-slot **123** in turn and be fixedly fastened to the left or right lateral surface of the tip portion of the rotation unit **200**.

If a predetermined tilting external force is provided to the tilting blocks **103** having this configuration when upward/downward tilting of the antenna device A coupled to tip portions of the tilting blocks **103** is required, after an upward or downward tilting motion is performed within a tilting angle range of the tilting guide slots **133** when an external force exceeding a friction force of the tilting braking washer pads **120** is provided, the tilting blocks **103** can be fixed.

Meanwhile, referring to FIG. **5**, the rotation unit **200** may include tilting unit installing stages **210** to which the tilting unit **100** is tiltably coupled, a rotating block **220** that is inserted into a mounting space **331** of the arm unit **300**, and a connecting block **230** that interconnects the tilting unit installing stages **210** and the rotating block **220**.

Here, the tilting unit installing stages **210** are provided apart from each other in a pair so as to extend from left and right ends of the connecting block **230** toward the tilting unit **100**. As described above, the tilting pins **140** acting as the tilting center of the tilting unit **100** may be provided on outer lateral surfaces of the tilting unit installing stages **210** so as to be connected with the tilting unit **100**.

That is, the above-described tilting blocks **103** of the tilting unit **100** are installed on the outer lateral surfaces of the tilting unit installing stages **210** of the rotation unit **200**, and may be provided in a pair like the tilting unit installing stages **210**.

As described above, the tilting guide bolts **135** are fixed to the outer lateral surfaces of the tilting unit installing stages **210** so as to pass through the tilting blocks **103**, the tilting guides **130**, and the tilting braking washer pads **120** of the tilting unit **100**, and tilting pin fastening holes **217** may be formed in the tilting unit installing stages **210** such that the

tilting pins **140** pass through and be fastened to the tilting blocks **103** of the tilting unit **100**.

In addition, the friction pads **212**, which provide friction surfaces against which the braking protrusions **125** of the tilting braking washer pads **120** are rubbed, may be installed in pad installation recesses **211** of the outer lateral surfaces of the tilting unit installing stages **210** by flat head screws **215**. The flat head screws **215** may install and fix the friction pads **212** by passing through friction pad installing holes **213** formed in the friction pads **212** and being fastened and fixed to friction pad fixing holes **219** of the tilting unit installing stages **210**. Therefore, the friction pads **212** can be easily replaced when worn by a continuous tilting motion.

Meanwhile, among the components of the rotation unit **200**, a rotating block **220** is a part which is inserted into and installed in the mounting space **331** provided in the tip portion of the arm unit **300** in a hollow form, and which enables the rotation unit **200** to be rotated in the mounting space **331** in a left-right direction.

Referring to FIG. **5**, the rotating block **220** may include a lower block **220***a* that comes into close contact with a lower surface of the mounting space **331** of the arm unit **300**, an upper block **220***b* that is provided at an upper side of the lower block **220***a* so as to be separated at a predetermined distance and comes into close contact with an upper surface of the mounting space **331**, and a center block **220***c* that interconnects the lower block **220***a* and the upper block **220***b*.

Meanwhile, referring to FIG. **5**, a rotating braking washer pad **240** performing the same function as the above-described tilting braking washer pads **120** may be interposed between the rotating block **220** and the arm unit **300**.

More specifically, if each of the tilting braking washer pads **120** is installed between the tilting unit installing stage **210** and the tilting unit **100** and produces a predetermined friction force during a tilting motion, the rotating braking washer pad **240** can produce a predetermined friction force between the rotating block **220** and the arm unit **300** during a rotating motion in a left-right direction and serve to prevent the antenna device A from being moved in a left-right direction by an arbitrary external force.

The rotating braking washer pad **240** may be mounted in a rotating braking washer pad mounting recess **221**, which is formed to be recessed from an upper surface of the upper block **220***b* among the components of the rotating block **220**, in a corresponding shape. Fastening holes **243** through which flat head screws **245** pass are provided in the rotating braking washer pad **240** so as to be across up and down, and fixing holes **225** to which the flat head screws **245** are fastened and fixed are formed in a part corresponding to the rotating braking washer pad mounting recess **221**. The rotating braking washer pad **240** can be fixed to the rotating braking washer pad mounting recess **221** by a process of the flat head screws **245** being fastened to the fastening holes **243** and the fixing holes **225** in turn.

A plurality of braking protrusions **241** are provided on an upper surface of the rotating braking washer pad **240**, and produce the above-described friction force between the upper surface of the rotating braking washer pad **240** and the upper surface of the hollow mounting space **331**.

Meanwhile, referring to FIG. **5**, an upper hinge fastening hole **222***a*, which forms a hinge point to which an upper rotating pin (see a reference numeral **335** of FIG. **6**) is fastened, may be formed in the upper block **220***b* among the components of the rotating block **220**, and a front guide bolt fastening hole **222***b* and a rear guide bolt fastening hole **222***c* to which a front rotation guide bolt **336***a* and a rear rotation guide bolt **336***b*, which are provided to guide leftward and rightward rotating motions of the rotation unit **200** acting as one component of the rotation guide of the arm unit **300** (to be described below), are fastened may be formed in the upper block **220***b*. In addition, because the upper rotating pin **335**, the front rotation guide bolt **336***a*, and the rear rotation guide bolt **336***b* are also through-fastened to the rotating braking washer pad **240**, an upper hinge through-hole **242***a*, a front guide bolt through-hole **242***b*, and a rear guide bolt through-hole **242***b* may be formed in the rotating braking washer pad **240**.

A lower hinge fastening hole (see a reference numeral **251** of FIG. **10**) in which a mounting guide unit (to be described below) is provided may be provided in the lower block **220***a* among the components of the rotating block **220**.

Meanwhile, the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure may further include a mounting guide unit (see a reference numeral **250** of FIG. **10**) provided to the lower block **220***a* among the components of the rotating block **220**.

The mounting guide unit **250** is provided to the rotation unit **200**, and serves to be temporarily fixed to the lower hinge fastening hole **251** that forms the hinge point in the mounting space **331** after being elastically compressed when the rotation unit **200** is mounted in the mounting space **331** of the arm unit **300**. Therefore, with the antenna device A, which is a predetermined weight body, coupled to the tip portion of the tilting unit **100**, the rotation unit **200** can be more easily fixed to the arm unit **300** along with the tilting unit **100**. This mounting guide unit **250** will be described in detail after the arm unit **300** is described first.

Meanwhile, referring to FIG. **6**, the arm unit **300** may include an outer mounting block **310** that is disposed to come into close contact with one side of an outer circumferential surface of the support pole **1**, an inner mounting block **320** that is disposed to come into close contact with the other side of the outer circumferential surface of the support pole **1** and is fixed with the outer mounting block **310** by at least one or more fixing bolts **325**, and a clamp arm **330** that extends from the inner mounting block **320** at a predetermined length in a direction orthogonal to the support pole **1** and constitutes a tip portion to which the mounting space **331** is provided.

The outer mounting block **310** may be formed of a steel material, and may form a frame. A support block **340**, in which an outer shape-fitting recess **343**, which is a part that substantially corresponds to a shape of the one side of the outer circumferential surface of the support pole **1**, is formed and which is formed of an elastic material having a high friction force such that a slip is not generated between the support block **340** and the support pole **1** to come into close contact, may be coupled to the outer mounting block **310** so as to be disposed between the outer mounting block **310** and the support pole **1**.

At least one or more outer bolt through-holes **311** through which fixing bolts **325** pass may be formed in left and right opposite ends of the outer mounting block **310** so as to be spaced up and down. Support bolt through-holes **341** may also be formed in the support block **340** at positions corresponding to the outer bolt through-holes **311**. Inner bolt through-holes **321** may also be formed in the inner mounting block **320** at positions corresponding to the outer bolt through-holes **311** and the support bolt through-holes **341**.

The outer mounting block **310**, the support block **340**, and the inner mounting block **320** are fastened such that the fixing bolts **325** pass through the inner bolt through-holes **321**, the support bolt through-holes **341**, and the outer bolt

through-holes **311** from the side of the inner mounting block **320** in turn, and then are firmly fastened using fastening nuts **360**, whereby the antenna device A can be stably supported.

Here, the fastening nuts **360** are fastened to nut fastening parts **313**, which are formed as empty spaces between the outer bolt through-holes **311** of the outer mounting block **310** and the support bolt through-holes **341**, in a hidden state, and thereby can be provided such that arbitrary disassembly is made difficult by a third person.

Among the components of the support block **340**, the outer shape-fitting recess **343**, which is a part that substantially comes into close contact with the one side of the outer circumferential surface of the support pole **1**, may be formed to be recessed in a shape corresponding to the outer circumferential surface of the support pole **1** in order to improve a close contact area with respect to the support pole **1** having a circular cross section. In addition, the outer shape-fitting recess **343** may be serration-machined such that multiple serration ribs are formed for a stronger friction force while being compressed on the outer circumferential surface of the support pole **1** by a fastening force from the fixing bolts **325** and the fastening nuts **360**.

Meanwhile, an inner shape-fitting recess **323** corresponding to the outer shape-fitting recess **343** of the support block **340** may be formed in an outer lateral surface of the inner mounting block **320**, i.e. a surface that substantially comes into close contact with the support pole **1**. The inner mounting block **320** is formed of a steel material for support rigidity. However, regardless of this, the inner shape-fitting recess **323** may also be subjected to serration machining such that multiple serration ribs are formed to prevent a slip from being generated between the inner mounting block **320** and the support pole **1**.

The inner mounting block **320** and the clamp arm **330** may be integrally molded. Here, the inner mounting block **320** may be formed such that an up-down-left-right area (i.e., a front area) thereof is relatively larger than that occupied by the clamp arm **330**. In addition, depending on an embodiment, a tip portion of the clamp arm **330** may be formed to have various distances spaced apart from the support pole **1** (see FIG. **15** to be described below).

When a length of the clamp arm **330** is relatively short, weight of the antenna device A can be sufficiently supported by an integral molding method of a connecting part between the inner mounting block **320** and the clamp arm **330**. However, when the length of the clamp arm **330** is relatively long, at least one or more reinforcement ribs (see a reference numeral **380** of FIG. **12**) may be formed at the connecting part between the inner mounting block **320** and the clamp arm **330**.

Furthermore, in the case where the length of the clamp arm **330** is formed relatively long, i.e. in the case where fatigue strength of the connecting part between the inner mounting block **320** and the clamp arm **330** due to the weight of the antenna device coupled to the tilting unit **100** and the length of the clamp arm **330** is not satisfied only by the formation of at least one or above-described reinforcement ribs **380**, the fatigue strength should be reinforced. To this end, the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure may further include a reinforcement wire unit (see a reference numeral **400** of FIGS. **12**, **13**, and **15** to be described below).

The reinforcement wire unit **400** may include a connecting wire **420**, one end of which is fixed to a part of the support pole **1** which corresponds to an upper portion of the arm unit **300**, and the other end of which is fixed to the clamp arm **330** of the arm unit **300**. An installing bracket **410** and a one-side connecting ring **411** to which the one end of the connecting wire **420** is connected may be provided to the part of the support pole **1**, and the other-side connecting ring **412** to which the other end of the connecting wire **420** is connected may be provided to a tip portion of the clamp arm **330** of the arm unit **300**.

As described above, this reinforcement wire unit **400** may be selectively installed in consideration of the length of the clamp arm **330** manufactured to have various lengths, the weight of the antenna device coupled to the tilting unit **100**, and the fatigue strength of the connecting part between the inner mounting block **320** and the clamp arm **330**.

An embodiment of the clamping apparatus **50** for an antenna according to the present disclosure is configured such that the clamp arm **330** as one component of the arm unit **300** is provided to have various lengths, thereby providing an advantage that causes installation work to be more easily completed while removing spatial limitations on multiple antenna devices (regardless of whether or not they are antenna devices of the same communication company) installed on one support pole **1**.

Meanwhile, referring to FIG. **6**, the mounting space **331** into which the rotating block **220** of the rotation unit **200** is rotably inserted and installed is provided to the tip portion of the clamp arm **330**. The clamp arm **330** is formed in the shape of a pipe which has an approximately rectangular vertical section and which has an empty space therein, and the empty space may be defined as the mounting space **331**.

A lower hinge hole **334***a* provided in the shape of a fastening hole, into which a lower rotating pin **337** (to be described below) is inserted and then is inserted into and fixed in the lower hinge fastening hole **251** formed in the lower block **220***a* of the rotating block **220**, may be formed in a lower surface of the mounting space **331** so as to be across up and down.

Moreover, an upper hinge hole **334***b* provided in the shape of a fastening hole, into which an upper rotating pin **335** (to be described below) is inserted and then is inserted into and fixed in the upper hinge fastening hole **222***a* formed in the upper block **220***b* of the rotating block **220**, may be formed in an upper surface of the mounting space **331** so as to be across up and down.

In addition, at least one rotation guide part **333** may be formed on an upper surface of the mounting space **331** in a slot hole shape so as to guide a rotating motion of the rotation unit **200**, and be formed at front and rear sides of the upper hinge hole **334***b* so as to be spaced apart from the front and rear sides.

Here, the rotation guide part **333** may include at least one rotation guide slot **333***a* and **333***b* that are formed on the same circumference in common with the upper hinge hole **334***b* acting as the above-described hinge point, and rotation guide bolts **336***a* and **336***b* that pass through the at least one rotation guide slot **333***a* and **333***b* from the outside and are fixed to the rotation unit **200**.

As described above, the rotation guide slots **333***a* and **333***b* may include a front guide slot **333***a* that is formed at a front side on the basis of the upper hinge hole **334***b*, and a rear guide slot **333***b* that is formed at a rear side on the basis of the upper hinge hole **334***b*.

In addition, the rotation guide bolts **336***a* and **336***b* may also include a front rotation guide bolt **336***a* that is inserted into and passes through the front guide slot **333***a* and is inserted into and fastened to the front guide bolt fastening hole **242***b* of the upper block **220***b* among the components of the rotation unit **200**, and a rear rotation guide bolt **336***b* that is inserted into and passes through the rear guide slot

333*b* and is inserted into and fastened to the rear guide bolt fastening hole **242***c* of the upper block **220***b* among the components of the rotation unit **200**.

Therefore, the rotation unit **200** can be rotated while being subjected to guidance and restriction of the front guide slot **333***a* and the rear guide slot **333***b* located at the front side and the rear side centering on the lower hinge hole **334***a* and the upper hinge hole **334***b* which form hinge points to which the lower rotating pin **337** and the upper rotating pin **335** are coupled when a worker provides an external force for a rotating motion in any one of leftward and rightward directions to the antenna device A coupled to the tilting unit **100**. In this case, a friction force caused by the rotating braking washer pad **240** provided between the rotating block **220** and the arm unit **300** is applied, whereby an arbitrary rotating motion caused by an external force other than the external force of the worker can be prevented.

Meanwhile, a rotating angle label **350**, which indicates positions of the rotation guide bolts **336***a* and **336***b* moving in the rotation guide slots **333***a* and **333***b* from a reference point at an angle, may be attached to the tip portion of the clamp arm **330**. The rotating angle label **350** is provided in the same form as the tilting angle label **150** to be provided to the tilting unit **100**, and detailed description thereof will be omitted.

FIG. **7** is a top view of FIG. **2** which illustrates a rotating motion caused by the rotation unit **200**. FIG. **8** is a side view of FIG. **2** which illustrates a tilting motion caused by the tilting unit **100**. FIG. **9** is a sectional view taken along line A-A of FIG. **8**.

Referring to FIGS. **7** to **9**, the rotating and tilting motions of the clamping apparatus **50** for an n antenna according to an embodiment of the present disclosure will be described below in greater detail.

First, looking at the rotating motion, in a state in which the antenna device A is coupled to the tip portion of the tilting unit **100**, when a predetermined external force is applied to the antenna device A or the rotation unit **200** as illustrated in FIGS. **7** and **9**, the rotation unit **200** is rotated in such a way that the front rotation guide bolt **336***a* and the rear rotation guide bolt **336***b* are rotated within a range of the front guide slot **333***a* and a range of the rear guide slot **333***b* on the basis of the hinge point (see a reference numeral **335** indicating the upper rotating pin in FIG. **7**) in the mounting space **331** of the clamp arm **330** of the arm unit **300**.

In this case, predetermined moment based on the support pole **1** is applied to the rotation unit **200** including the antenna device A, but the outer shape-fitting recess **343** and the inner shape-fitting recess **323** formed in the arm unit **300** are formed by serration machining and are firmly coupled to the support pole **1** in close contact with the support pole **1**, whereby arbitrary movement during the rotating motion can be prevented.

After a rotating angle for the antenna device A is adjusted, an arbitrary rotating motion is prevented by the rotating braking washer pad **240** provided between the arm unit **300** and the rotation unit **200**, whereby reliability of work is increased.

Next, looking at the tilting motion, in a state in which the antenna device A is coupled to the tip portion of the tilting unit **100**, when a predetermined external force is applied to the antenna device A or the tilting unit **100** as illustrated in FIGS. **8** and **9**, the tilting unit **100** is tilted in such a way that the tilting guide bolts **135** are relatively tilted within ranges of the tilting guide slots **133** of the tilting guides **130** on the basis of the tilting pins **140**. Here, it should be noted that it is described that the tilting guide bolts **135** are in a state fixed to the rotation unit **200**, thus are not substantially moved, and are relatively tilted by the tilting motion of the tilting unit **100**.

After a tilting angle for the antenna device A is adjusted, an arbitrary tilting motion is prevented by the tilting braking washer pads **120** provided between the rotation unit **200** and the tilting unit **100**, whereby reliability of work is increased.

FIG. **10** is a cutaway perspective view and an enlarged view illustrating the mounting guide unit among the components of FIG. **2**, and FIGS. **11**A to **11**C are side sectional views illustrating an operating state of the mounting guide unit of FIG. **10**.

Referring to FIGS. **10** to **11**C, the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure may further include the mounting guide unit **250** provided to the rotation unit **200**.

Referring to FIG. **10**, the mounting guide unit **250** may include a guide tube **260** that is provided such that an outer end thereof can protrude outward from the lower hinge fastening hole **251**, which is provided such that a part of the rotation unit **200** which corresponds to a hinge point in the mounting space **331** is recessed upward, at a predetermined length, and an elastic body **280** that elastically supports the guide tube **260** in an outward direction of the rotation unit **200**.

Here, the mounting guide unit **250** may be provided to the lower hinge fastening hole **251** formed in the lower block **220***a* of the rotation unit **200**. In addition, the elastic body **280** may be provided as a coil spring that is interposed between an outer circumferential surface of the guide tube **260** and an inner circumferential surface of the lower hinge fastening hole **251**.

Internal threads **252** are formed on an inner circumferential surface (i.e. an inner circumferential surface adjacent to the outside) of a lower end of the lower hinge fastening hole **251**. The mounting guide unit **250** may further include an anti-separation nut **270** that is screwed to the internal threads **252** formed in the inner circumferential surface of the lower hinge fastening hole **251** so as to prevent outward separation of the guide tube **260**.

This anti-separation nut **270** is located between the outer circumferential surface of the guide tube **260** and the inner circumferential surface of the lower hinge fastening hole **251**, and a hanging rib **261** hung on the anti-separation nut **270** may be formed radially outward on the outer circumferential surface of the guide tube **260** so as to extend in a circumferential direction. One end of the elastic body **280** interposed between the outer circumferential surface of the guide tube **260** and the inner circumferential surface of the lower hinge fastening hole **251** may be fixedly supported on an upper side of the hanging rib **261**.

An outer end of the guide tube **260** may protrude at a length at which the guide tube **260** can be inserted into and caught in the hinge hole (i.e., the lower hinge hole **334***a*) formed at the hinge point in the mounting space **331** of the arm unit **300**.

Referring to FIG. **11**A, the mounting guide unit **250** provided in this way is illustrated before the tilting unit **100** to which the antenna device A is coupled and the rotation unit **200** are mounted on the arm unit **300**, and the guide tube **260** maintains a state protruding outward from the lower hinge fastening hole **251** at a predetermined length.

Next, referring to FIG. **11**B, the mounting guide unit **250** is inserted into a lower surface of a work space after a worker arbitrarily pushes the guide tube **260** into the lower

hinge fastening hole **251** in order to insert and install the rotating block **220** of the rotation unit **200** into and in the mounting space **331**.

Finally, if the worker continuously inserts the tilting unit **100** to which the antenna device A is coupled and the rotation unit **200** into the mounting space **331**, the guide tube **260** is inserted into the lower hinge hole **334***a* by an elastic force of the elastic body **280** at a side where the lower hinge hole **334***a* is located, whereby temporary fixing is completed. Assembly work may be completed by a process of causing the lower rotating pin **337** to pass through the lower hinge hole **334***a* from the outside and to be fastened to the lower hinge fastening hole **251**.

In this way, the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure can greatly improve work performance in the field by coupling the antenna device A provided as a somewhat large weight body to the tilting unit **100** to which the antenna device A is coupled, and by coupling the rotation unit **200** to the arm unit **300** through the mounting guide unit **250** by a one-touch coupling method.

FIG. **12** is a perspective view illustrating an example of an installed state of the antenna device, as a modification of the arm unit and the tilting unit among the components of an embodiment of the clamping apparatus **50** for an antenna according to the present disclosure. FIG. **13** is an exploded perspective view of FIG. **12**. FIGS. **14**A and **14**B are a perspective view and an exploded perspective view illustrating a state in which the antenna device is installed on the tilting unit of FIG. **12**.

Referring to FIGS. **12** to **14**B, the tilting unit **100** on which the antenna device A is substantially installed may further include an expansion connector **105** that is expanded to connect the antenna coupling stage **101** and the tilting block **103** in a left-right direction.

When a vertical length of the antenna device A is relatively larger, the expansion connector **105** is an additional component for improving a coupling force with respect to the antenna device A. That is, as a difference from the tilting unit **100** illustrated in FIGS. **1** to **11**C, the tilting unit **100** illustrated in FIGS. **12** to **14**B may have an additional advantage in that fastening points can be formed at multiple parts of the antenna device A, the vertical length of which is formed relatively long.

The expansion connector **105** is bent to have surfaces orthogonal to the antenna coupling stage **101** and the tilting block **103**, and may include multiple reinforcement ribs **107** that are additionally formed in the front in order to reinforce mechanical fatigue strength with respect to the weight of the antenna device A.

Meanwhile, referring to FIGS. **13** to **14**B, the antenna coupling stage **101** may have at least two or more fastening flanges **106** in which U-shaped fastening holes **106'** having open upper sides are formed such that fixing screws **110'**, which are previously fastened to a plurality of places **21** of lateral surfaces of the antenna device A in a temporarily fixed form, are hung downward and then screwed.

In FIG. **13** illustrated as a modification of the tilting unit **100**, the fastening flanges **106** are provided at left upper and lower ends and right upper and lower ends of the antenna coupling stages **101** so as to be spaced apart from each other, and fastening flanges (not indicated by a reference numeral), in which ordinary fastening holes **101'** different from the U-shaped fastening holes **106'** are formed in left and right middle parts of the antenna coupling stages **101**, are provided, so that the antenna coupling stages **101** can be provided to be coupled with the antenna device A in a total of six places.

Here, referring to FIG. **14**B, the antenna coupling stages **101** of the tilting unit **100** are moved from below to above the fixing screws **110'** that are previously fastened to screwing holes **22** formed in the plurality of places **21** of the lateral surfaces of the antenna device A in a temporarily fixed form, and the fixed fixing screws **110'** are hung on the U-shaped fastening holes **106'** of the antenna coupling stages **101**, and can be turned and firmly fixed.

In this way, the expansion connectors **105** provide an advantage in that they are fixed to the screwing holes **22** provided adjacent to ends of the antenna device A and thus the antenna device A in which a left-right width or an up-down length thereof is formed long on the whole can be stably installed in equilibrium.

Meanwhile, referring to FIGS. **1** and **12**, the support pole **1** may be provided with multiple support rods **3** that slantly extend downward from an outer circumferential surface of the support pole **1** and are radially spaced apart from one another at a predetermined angle, and supporting panels **5** that are provided at tips of the multiple support rods **3** and are supported and coupled to a ground or a wall.

The multiple support rods **3** may be fixed to the support pole **1** by welding and be formed integrally with the support pole **1**, as well as the multiple support rods **3** may be separately manufactured to be coupled to the support pole **1** by various coupling methods such as a bolting method.

Further, the supporting panels **5** may include bolt fastening holes (not illustrated) that are coupled to the ground or the wall using fastening members such as bolts.

FIG. **15** is a perspective view illustrating various embodiments of the arm unit among the components of FIG. **2**.

Referring to FIG. **15**, in an embodiment of the clamping apparatus **50** for an antenna according to the present disclosure, the arm unit **300** may be manufactured at various lengths such that a separation distance between the support pole **1** and the antenna device A differs.

Here, as the length of the arm unit **300** becomes relatively longer, fatigue strength caused by the weight of the antenna device A coupled to the tip portion of the tilting unit **100** and the length of the arm unit **300** itself is taken into consideration, and it goes without saying that, as described above, the reinforcement ribs **380** and the reinforcement wire unit **400** can be selectively provided.

More specifically, referring to FIG. **15**, when the length of the clamp arm **330** is formed relatively long, and when fatigue strength of the connection part between the inner mounting block **320** and the clamp arm **330** depending on the weight of the antenna device A coupled to the tilting unit **100** and the length of the clamp arm **330** is not satisfied only by the formation of the at least one or more above-described reinforcement ribs **380**, the clamping apparatus **50** for an antenna according to an embodiment of the present disclosure may further include the reinforcement wire unit **400** for reinforcing this.

The reinforcement wire unit **400** may provided with a connecting wire **420**, one end of which is fixed to a part of the support pole **1** which corresponds to an upper portion of the arm unit **300**, and the other end of which is fixed to the clamp arm **330** of the arm unit **300**. An installing bracket **410** and a one-side connecting ring **411** for connecting the one end of the connecting wire **420** may be provided to the part of the support pole **1**, and the other-side connecting ring **412**

for connecting the other end of the connecting wire **420** may be provided to the tip portion of the clamp arm **330** of the arm unit **300**.

As described above, this reinforcement wire unit **400** may be selectively installed in consideration of the fatigue strength of the connection part between the inner mounting block **320** and the clamp arm **330** depending on the length of the clamp arm **330** manufactured to have various lengths and the weight of the antenna device A coupled to the tilting unit **100**.

An embodiment of the clamping apparatus **50** for an antenna according to the present disclosure includes the clamp arm **330** as one component of the arm unit **300** so as to have various lengths, thereby providing an advantage that causes installation work to be more easily completed while removing spatial limitations on multiple antenna devices A (regardless of whether or not they are antenna devices of the same communication company) installed on one support pole **1**.

An embodiment of the clamping apparatus for an antenna according to the present disclosure has been described in detail with reference to the accompanying drawings. However, it goes without saying that embodiments of the present disclosure are not necessarily restricted by the embodiment described above and can be modified and carried out in an equivalent range by those skilled in the art to which the present disclosure pertains. Therefore, the scope of rights of the present disclosure will be defined by the following claims.

INDUSTRIAL APPLICABILITY

The present disclosure provides the clamping apparatus for an antenna which can increase a degree of freedom of installation with respect to a support pole having many spatial limitations and improve workability.

What is claimed is:

1. A clamping apparatus, comprising:

an arm unit configured to be coupled to a support pole and having a mounting space formed in a tip portion thereof; and

a rotation unit comprising a rotating block which is configured to be inserted into the mounting space of the arm unit and tilting unit installing stages provided at an opposite side of the rotating block, wherein the rotating block is configured to be detachably mounted in the mounting space of the arm unit and rotatable about a hinge point in the mounting space at a predetermined angle in a left-right direction,

wherein the rotating block comprises a mounting guide unit having an upper surface and a lower surface, and the mounting guide unit comprises a guide tube provided on the lower surface and configured to protrude from the lower surface to penetrate a hinge hole provided on a lower surface of the mounting space of the arm unit at a corresponding location of the hinge point.

2. The clamping apparatus according to claim **1**,

wherein the mounting guide unit further comprises a lower hinge fastening hole provided at a corresponding location of the hinge point, wherein the guide tube is provided such that an outer end thereof protrudes downward from the lower hinge fastening hole at a predetermined length.

3. The clamping apparatus according to claim **1**, wherein the rotation unit further comprises an elastic body which is configured to protrude the guide tube downward through the hinge hole.

4. The clamping apparatus according to claim **1**, wherein the arm unit further comprises a lower rotating pin which is configured to pass through the hinge hole and be inserted into and installed in the guide tube.

5. The clamping apparatus according to claim **2**, wherein the mounting guide unit further comprises an anti-separation nut that is screwed to an inner circumferential surface of the lower hinge fastening hole.

6. The clamping apparatus according to claim **5**, wherein:

the anti-separation nut is located between an outer circumferential surface of the guide tube and the inner circumferential surface of the lower hinge fastening hole.

7. The clamping apparatus according to claim **1**, wherein the arm unit comprises:

an outer mounting block that is disposed to be in contact with one side of an outer circumferential surface of the support pole;

an inner mounting block that is disposed to be in contact with the other side of the outer circumferential surface of the support pole and is fixed with the outer mounting block by at least one or more fixing bolts; and

a clamp arm that extends from the inner mounting block at a predetermined length in a direction orthogonal to the support pole and constitutes a tip portion to which the mounting space is provided.

8. The clamping apparatus according to claim **7**, wherein at least one or more reinforcement ribs are formed at a connection part between the inner mounting block and the clamp arm.

9. The clamping apparatus according to claim **7**, wherein the clamp arm is manufactured at multiple preset lengths so as to be installable in a different separation distance from the support pole depending on another antenna device, which is installed adjacent to an antenna device coupled to the tilting unit, and surrounding interference bodies.

10. The clamping apparatus according to claim **1**, further comprising:

a tilting unit configured to be coupled to the tilting unit installing stages and is tiltable in an up-down direction and configured to be coupled to an antenna device.

11. A clamping apparatus, comprising:

an arm unit comprising a first end and a second end, wherein the first end of the arm unit is configured to be coupled to a support pole, and the second end of the arm unit has a mounting space; and

a rotation unit comprising a first end and a second end, wherein the first end of the rotation unit is configured to be detachably mounted in the mounting space of the arm unit, the first end of the rotation unit comprises a rotating block which is configured to be inserted into the mounting space of the arm unit,

wherein the rotating block is configured to rotate about a hinge point in the mounting space at a predetermined angle in a left-right direction,

wherein the rotating block comprises a mounting guide unit having an upper surface and a lower surface, and the mounting guide unit comprises a guide tube provided on the lower surface and configured to protrude from the lower surface to penetrate a hinge hole provided on a lower surface of the mounting space of the arm unit at a corresponding location of the hinge point.

12. The clamping apparatus according to claim **11**,

wherein the mounting guide further comprises a lower hinge fastening hole provided at a corresponding location of the hinge point, wherein the guide tube is

provided such that an outer end thereof protrudes downward from the lower hinge fastening hole at a predetermined length.

13. The clamping apparatus according to claim **11**, wherein the rotation unit further comprises an elastic body which is configured to protrude the guide tube downward through the hinge hole.

14. The clamping apparatus according to claim **11**, wherein the arm unit further comprises a lower rotating pin which is configured to pass through the hinge hole and be inserted into and installed in the guide tube.

15. The clamping apparatus according to claim **12**, wherein the mounting guide unit further comprises an anti-separation nut that is screwed to an inner circumferential surface of the lower hinge fastening hole.

16. The clamping apparatus according to claim **15**, wherein:

the anti-separation nut is located between an outer circumferential surface of the guide tube and the inner circumferential surface of the lower hinge fastening hole.

17. The clamping apparatus according to claim **11**, wherein the arm unit comprises:

an outer mounting block that is disposed to be in contact with one side of an outer circumferential surface of the support pole;

an inner mounting block that is disposed to be in contact with the other side of the outer circumferential surface of the support pole and is fixed with the outer mounting block by at least one or more fixing bolts; and

a clamp arm that extends from the inner mounting block at a predetermined length in a direction orthogonal to the support pole and constitutes a tip portion to which the mounting space is provided.

18. The clamping apparatus according to claim **17**, wherein at least one or more reinforcement ribs are formed at a connection part between the inner mounting block and the clamp arm.

19. The clamping apparatus according to claim **17**, wherein the clamp arm is manufactured at multiple preset lengths so as to be installable in a different separation distance from the support pole depending on another antenna device, which is installed adjacent to an antenna device coupled to the tilting unit, and surrounding interference bodies.

20. The clamping apparatus according to claim **11**, further comprising:

a tilting unit comprising a first end and a second end, wherein the first end of the tilting unit is configured to be coupled to the second end of the rotation unit and is tiltable in an up-down direction and the second end of the tilting unit is configured to be coupled to an antenna device.

* * * * *