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(54) **POLARIZATION DEVICE FOR MICROWAVE OUTDOOR TRANSMISSION SYSTEM**

(57) Embodiments of the present invention relate to a polarization device used for a microwave outdoor transmission system. A polarization device used for a microwave outdoor transmission system. The microwave outdoor transmission system includes an antenna and an outdoor active device. The polarization device includes: a first polarization component, where the first polarization component is fixed, in a removable manner, onto the outdoor active device, so that a waveguide of the first polarization component keeps staying in a same direction with a waveguide of the outdoor active device; and a second polarization component, where the second polarization component is fixed, in a removable manner, onto the first polarization component, so as to allow an included angle between a waveguide of the second polarization component and the waveguide of the first polarization component to be adjusted through rotation of the second polarization component in relation to the first polarization component. According to the embodiments of the present invention, convenient and fast switching between horizontal polarization and vertical polarization can be implemented by using a simple structure, and the polarization device can be compatible with an existing antenna and implement reconstruction of the existing antenna, thereby saving a cost of replacing the existing antenna.

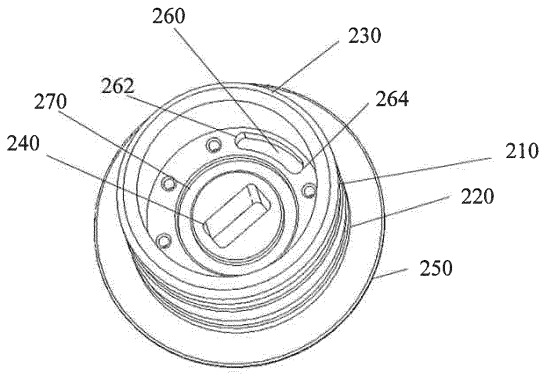


FIG. 6

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## Description

### CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority to Chinese Patent Application No. 201110448741.2, filed on December 28, 2011 and entitled "POLARIZATION DEVICE USED FOR MICROWAVE OUTDOOR TRANSMISSION SYSTEM", and to Chinese Patent Application No. 201120560188.7, filed on December 28, 2011 and entitled "POLARIZATION DEVICE USED FOR MICROWAVE OUTDOOR TRANSMISSION SYSTEM", both of which are incorporated herein by reference in their entireties.

### TECHNICAL FIELD

**[0002]** Embodiments of the present invention relate to the field of microwave communications, and in particular, to a polarization device used for a microwave outdoor transmission system.

### BACKGROUND

**[0003]** In an existing microwave communications system, to make full use of spectrum resources and reduce interference between microwave transmission signals, a microwave outdoor transmission system will use two manners, vertical polarization and horizontal polarization, to transmit a signal. Therefore, a polarization manner of an outdoor active device in the microwave outdoor transmission system needs to be compatible with the two polarization manners, horizontal polarization and vertical polarization.

**[0004]** For example, a polarization scheme supporting the two polarization manners is implemented by using two polarization components. That is, one polarization component supports horizontal polarization, the other polarization component supports vertical polarization, and switching between the two polarization manners is implemented by replacing the two components. In this polarization scheme, an input end of a polarization component is a horizontal polarization direction, and an electric field direction of an output end is horizontal polarization or vertical polarization. In practical use of the two polarization components, one polarization component is assembled in an antenna system, and the other polarization component is stored in an auxiliary material package. A risk of losing a polarization component may occur during an onsite operation. In addition, a polarization component needs to be replaced on site to change a polarization manner, causing operation complexity.

**[0005]** For example, another polarization scheme supporting the two polarization manners is implemented by using a specially-made dedicated polarization component. In this polarization scheme, an electric field of an input end of the polarization component is a 45-degree direction, and an electric field direction of an output end of the polarization component is horizontal polarization or vertical polarization. When this polarization scheme is used, the specially-made dedicated polarization component needs to be installed at an antenna end. Due to particularity of the polarization component, the entire antenna end needs to be replaced, so as to install the polarization component. However, generally in a microwave communications system, replacing the antenna end is not convenient and involves a high replacement cost. Therefore, this polarization scheme cannot be compatible with the existing antenna end.

**[0006]** Therefore, a polarization device needs to be provided, which supports the two polarization manners, can conveniently switch between the two polarization manners, and is compatible with an existing antenna.

### SUMMARY

**[0007]** Embodiments of the present invention provide a polarization device used for a microwave outdoor transmission system.

**[0008]** According to one aspect, a polarization device used for a microwave outdoor transmission system is provided. The microwave outdoor transmission system includes an antenna and an outdoor active device. The polarization device includes:

a first polarization component, where the first polarization component is fixed, in a removable manner, onto the outdoor active device, so that a waveguide of the first polarization component keeps staying in a same direction with a waveguide of the outdoor active device; and

a second polarization component, where the second polarization component is fixed, in a removable manner, onto the first polarization component, so as to allow an included angle between a waveguide of the second polarization component and the waveguide of the first polarization component to be adjusted through rotation of the second polarization component in relation to the first polarization component.

**[0009]** According to another aspect, a microwave outdoor transmission unit is provided. The microwave outdoor transmission unit includes the polarization device according to an embodiment of the present invention.

**[0010]** According to another aspect, a communications system is provided. The communications system includes the microwave outdoor transmission unit according to an embodiment of the present invention.

**[0011]** According to the embodiments of the present invention, convenient and fast switching between horizontal polarization and vertical polarization can be implemented by using a simple structure, and the polarization device can be compatible with an existing antenna, thereby saving a cost of replacing the existing antenna.

## BRIEF DESCRIPTION OF DRAWINGS

**[0012]** To describe the technical solutions in the embodiments of the present invention more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments or the prior art. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is an assembly diagram of a polarization device according to an embodiment of the present invention;

FIG. 2 is a perspective view of a first polarization component of a polarization device according to an embodiment of the present invention;

FIG. 3 is a perspective view of a second polarization component of a polarization device according to an embodiment of the present invention;

FIG. 4 is a schematic diagram of relative relationships between waveguides of various components during implementation of horizontal polarization according to an embodiment of the present invention;

FIG. 5 is a schematic diagram of relative relationships between waveguides of various components during implementation of vertical polarization according to an embodiment of the present invention;

FIG. 6 is a perspective view of a first polarization component of a polarization device according to an exemplary embodiment of the present invention;

FIG. 7 is a perspective view of a second polarization component of a polarization device according to an exemplary embodiment of the present invention; and

FIG. 8 is a perspective view of a sealing ring of a polarization device according to an exemplary embodiment of the present invention.

## DESCRIPTION OF EMBODIMENTS

**[0013]** The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely a part rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

**[0014]** FIG. 1 is an assembly diagram of a polarization device 10 according to an embodiment of the present invention, where the polarization device 10 is used for a microwave outdoor transmission system. Generally, the microwave outdoor transmission system includes an antenna (not shown in the figure) and an outdoor active device 100. The outdoor active device is usually a microwave outdoor module, which includes a power supply, an intermediate frequency active transceiving link, a radio frequency (including a microwave frequency band) active transceiving link, a duplexer, and an auxiliary structural part. In this embodiment of the present invention, for horizontal polarization and vertical polarization of the antenna, a waveguide of the outdoor active device 100 of the microwave outdoor transmission system is at an included angle of 45 degrees with a waveguide of the antenna. As shown in FIG. 1, the polarization device 10 mainly includes a first polarization component 200 and a second polarization component 300. The first polarization component 200 is fixed, in a removable manner, onto the outdoor active device 100 of the microwave outdoor transmission system, so that a waveguide of the first polarization component 200 keeps staying in a same direction with a waveguide of the outdoor active device 100. The second polarization component 300 is fixed, in a removable manner, onto the first polarization component 200, so as to allow an included angle between the waveguide of the first polarization component 200 and a waveguide of the second polarization component 300 to be adjusted through rotation of the second polarization component 300 in relation to the first polarization component 200. The following specifically describes the polarization device 10.

**[0015]** A person skilled in the art understands that generally the waveguide of the antenna and the waveguide of the outdoor active device may be arranged into a rectangular waveguide port, so as to facilitate radio wave transmitting. For the polarization device 10 according to this embodiment of the present invention, the waveguide of the first polarization component 200 and the waveguide of the second polarization component 300 are also preferentially arranged into a rectangular waveguide port, and their shapes and sizes correspond to those of the waveguide of the antenna and the waveguide of the outdoor active device 100.

**[0016]** FIG. 2 shows a perspective view of the first polarization component 200 according to an embodiment of the present invention. What is shown in FIG. 2 is a preferential scheme of the first polarization component 200. The first polarization component 200 is basically a cylindrical pipe 210, where the cylindrical pipe has a closed end 220 and an open end 230. Therefore, the first polarization component 200 is basically in a cup shape. A waveguide 240 of the first polarization component 200 is arranged in a center of the closed end 220 of the cylindrical pipe 210, that is, arranged in a center of a bottom of the cup-shaped component. The waveguide 240 may be arranged into a rectangular waveguide port, and its shape corresponds to that of a waveguide of the outdoor active device 100. The closed end 220 of the cylindrical pipe 210 has a flange part 250. The first polarization component 200 is fixed, by using a fastener (not shown in the figure), onto the outdoor active device 100 through a fastener hole (not shown in the figure) on the flange part 250. A person skilled in the art may understand that there

may be multiple fastener holes on the flange part 250, and preferentially they are distributed evenly around the flange part 250. A bolt may be selected as the fastener for fixing the first polarization component 200 onto the outdoor active device. In this case, a corresponding thread hole is arranged on the outdoor active device, so as to accept the fastener.

**[0017]** FIG. 3 shows a perspective view of the second polarization component 300 according to an embodiment of the present invention. What is shown in FIG. 3 is a preferential scheme of the second polarization component 300. The second polarization component 300 is basically a cylinder 310, and has a first end surface 320 and a second end surface 330 (see FIG. 7). An outer diameter of the cylinder 310 basically mates with an inner diameter of the cylindrical pipe 210 of the first polarization component 200 shown in FIG. 2, so that the cylinder 310 can be inserted into the cylindrical pipe 210 to implement assembly of the first polarization component 200 and the second polarization component 300. During the assembly of the first polarization component 200 and the second polarization component 300, the second end surface 330 of the cylinder 310 faces an inner side of the closed end 220 of the cylindrical pipe 210. A waveguide 340 of the second polarization component 300 is in a form of a rectangular waveguide port, threads through the first end surface 320 and the second end surface 330 of the cylinder 310, and is arranged in a center of the first end surface 320. A shape and a size of the waveguide 340 correspond to those of the waveguide 240 of the first polarization component 200. When the second polarization component 300 cooperates with the first polarization component 200, the second polarization component 300 can be rotated in relation to the first polarization component 200 to adjust an included angle between the waveguide 340 of the second polarization component 300 and the waveguide 240 of the first polarization component 200, so as to implement switching between horizontal polarization and vertical polarization of an antenna. Here, an included angle between the waveguides refers to an included angle between longitudinal axes of rectangles of various waveguides, and it is the same below. The second polarization component 300 is fixed, by using a fastener, onto the first polarization component 200 through a passing-through fastener hole 350 that is arranged around the cylinder 310. A person skilled in the art may understand that there may be multiple fastener holes 350 on the cylinder 310, and preferentially they are distributed evenly around the cylinder. A bolt may be selected as the fastener for fixing the second polarization component 300 onto the first polarization component 200. In this case, a corresponding thread hole 290 (see FIG. 2) is arranged at the closed end 220 of the fastener 200, so as to accept the fastener.

**[0018]** The following describes in detail, with reference to FIG. 4 and FIG. 5, configuration for implementing horizontal polarization and vertical polarization by using the first polarization component 200 and the second polarization component 300.

**[0019]** FIG. 4 shows relative location relationships between waveguide ports of various components when horizontal polarization is implemented on the antenna by using the first polarization component 200 and the second polarization component 300. For clear exemplary description, the figure is simplified and only the waveguide ports of the components are shown. FIG. 4 shows a top view of the waveguide ports stacked together when the antenna, the outdoor active device, the first polarization component 200, and the second polarization component 300 are installed together. Two-dot dashed lines indicate the waveguide of the antenna during horizontal polarization, single-dot dashed lines indicate the waveguide of the outdoor active device 100 and the waveguide 240 of the first polarization component 200, and real lines indicate the waveguide 340 of the second polarization component 300, where the waveguide of the outdoor active device 100 and the waveguide 240 of the first polarization component 200 are kept in a same direction. For ease of description, in FIG. 4, it is considered during horizontal polarization that an azimuth of the waveguide of the antenna is 0 degrees, and azimuths of the waveguide 240 of the first polarization component 200 and the waveguide of the outdoor active device are 45 degrees. That is, included angles between the two and the waveguide of the antenna separately are 45 degrees. An azimuth of the waveguide 340 of the second polarization component 300 is 22.5 degrees. That is, an included angle between the waveguide 340 of the second polarization component 300 and the waveguide 240 of the first polarization component 200 is 22.5 degrees. In this way, the horizontal polarization of the antenna is implemented with the configuration.

**[0020]** FIG. 5 shows the relative location relationships between the waveguide ports of various components when vertical polarization is implemented on the antenna by using the first polarization component 200 and the second polarization component 300. Likewise, for clear exemplary description, the figure is simplified and only the waveguide ports of the components are shown. FIG. 5 shows a top view of the waveguide ports stacked together when the antenna, the outdoor active device, the first polarization component 200, and the second polarization component 300 are installed together. Two-dot dashed lines indicate the waveguide of the antenna during vertical polarization, single-dot dashed lines indicate the waveguide of the outdoor active device 100 and the waveguide 240 of the first polarization component 200, and real lines indicate the waveguide 340 of the second polarization component 300, where the waveguide of the outdoor active device 100 and the waveguide 240 of the first polarization component 200 are kept in a same direction.For ease of description, in FIG. 5, it is considered during horizontal polarization that the azimuth of the waveguide of the antenna is 90 degrees, and the azimuths of the waveguide 240 of the first polarization component 200 and the waveguide of the outdoor active de-

vice 100 are 45 degrees. That is, an included angle between the waveguide 240 of the first polarization component 200 and the waveguide of the antenna is 45 degrees, and an included angle between the waveguide of the outdoor active device 100 and the waveguide of the antenna is 45 degrees. The azimuth of the waveguide 340 of the second polarization component 300 is 67.5 degrees. That is, the included angle between the waveguide 340 of the second polarization component 300 and the waveguide 240 of the first polarization component 200 is 22.5 degrees. In this way, the vertical polarization of the antenna is implemented with the configuration.

**[0021]** As can be seen from FIG. 4 and FIG. 5, the waveguide 240 of the first polarization component 200 is always installed at an angle of 45 degrees, whereas the included angle between the waveguide 340 of the second component 300 and the waveguide 240 of the first polarization component 200 is 22.5 degrees but the two waveguides face different directions. If it is considered in FIG. 4 that the included angle between the waveguide 340 of the second component 300 and the waveguide 240 of the first polarization component 200 is -22.5 degrees, it can be considered that in FIG. 5, the included angle between the waveguide 340 of the second component 300 and the waveguide 240 of the first polarization component 200 is 22.5 degrees. Therefore, flexible switching between the horizontal polarization and the vertical polarization of the antenna can be implemented by adjusting an angle of rotation of the second polarization component 300 in relation to the first polarization component 200.

**[0022]** Certainly, the present invention is not limited to the switching between the horizontal polarization and the vertical polarization of the antenna. A person skilled in the art understands that any polarization angle of the antenna may also be implemented through the relative rotation between the second polarization component 300 and the first polarization component 200.

**[0023]** In an embodiment of the present invention, common horizontal polarization and vertical polarization are further improved. FIG. 6 is an exemplary structure of the first polarization component 200 according to an embodiment of the present invention. As shown in FIG. 6, the inner side of the closed end 220 of the cylindrical pipe 210 of the first polarization component 200 includes an arc groove 260, where the arc groove 260 extends along a circumferential direction of the cylindrical pipe 210, and its span is 45 degrees. The arc groove 260 has a first end 262 and a second end 264, so as to cooperate with a corresponding bulge (described below) on the second polarization component 300, thereby implementing the horizontal polarization and the vertical polarization of the antenna. FIG. 7 is an exemplary structure of the second polarization component 300 according to an embodiment of the present invention. As shown in FIG. 7, the second end surface 330 of the cylinder 310 of the second polarization component 300 includes a bulge 340 arranged on a surrounding edge. When the first polarization component 200 shown in FIG. 6 cooperates with the second polarization component 300 shown in FIG. 7, the bulge 340 cooperates inside the arc groove 360. According to an embodiment of the present invention, a position of the arc groove 260 at the closed end 220 and/or a position of the bulge 340 on the second end surface 330 may be selected, so that the horizontal polarization of the antenna is implemented when the bulge 340 is located at the first end 262 of the arc groove 260, whereas the vertical polarization of the antenna is implemented when the bulge 340 is located at the second end 264 of the arc groove 260.

**[0024]** By arranging the arc groove 260 on the first polarization component 200 and arranging the bulge 340 on the second polarization component to cooperate with the arc groove 260, precise positioning can be ensured when the rotation of the second polarization component 300 in relation to the first polarization component 200 is adjusted, and the cooperation between the bulge and the arc groove can provide a foolproof function, thereby avoiding incorrect positioning of the second polarization component 300 in relation to the first polarization component.

**[0025]** Although not indicated, according to an embodiment of the present invention, the fastener hole 350 on the second polarization component 300 shown in FIG. 7 may be arranged into an arc hole, where the fastener hole 350 is used to fix the second polarization component 300 onto the first polarization component 200, and a span of the arc hole corresponds to the span of the arc groove 260. In this way, when the angle of rotation of the second polarization component 300 in relation to the first polarization component 200 is adjusted, the second polarization component 300 does not need to be taken out of the first polarization component 200. Instead, what is only required is to loosen the fastener, rotate the second polarization component 300, and tighten the fastener after an expected position is reached. This arrangement can prevent accidental damage or a loss of the second polarization component during the adjustment of the angle. According to this embodiment of the present invention, the number of arc holes is at least one, so as to provide a more reliable fixing effect.

**[0026]** A person skilled in the art may understand that the span of the arc groove 260 is not limited to 45 degrees. A greater or smaller span may be selected according to a specific application requirement, so as to implement polarization of different angles. According to an exemplary embodiment, the span of the arc groove 260 is at least 45 degrees. In an embodiment in which the fastener hole 350 on the second polarization component 300 is an arc hole, the span of the arc hole is correspondingly at least 45 degrees.

**[0027]** According to an embodiment of the present invention, on the inner side of the closed end 220 of the first polarization component 200 shown in FIG. 6, an annular groove 270 is arranged on a communications

ground between the waveguide 240 and the cylindrical pipe 210. In practical use, a sealing ring 280 (shown in FIG. 8) may be arranged in the annular groove 270, so that the sealing ring 280 provides a waterproof sealing function when the second polarization component 300 cooperates with the first polarization component 200. A silicon rubber material may be chosen for the sealing ring 280, so as to ensure electrical transmission performance while providing waterproof sealing.

**[0028]** According to an embodiment of the present invention, the first polarization component 200 and the second polarization component 300 may be made of an aluminum alloy material. Metal, such as gold or silver, may be electroplated on surfaces of the waveguide 240 of the first polarization component 200 and the waveguide 340 of the second polarization component 300, so as to further improve polarization efficiency.

**[0029]** According to the embodiments of the present invention, convenient and fast switching between horizontal polarization and vertical polarization can be implemented by using a simple structure, and the polarization device can be compatible with an existing antenna and implement reconstruction of the existing antenna, thereby saving a cost of replacing the existing antenna.

**[0030]** According to another aspect of the embodiments of the present invention, a microwave outdoor transmission unit is provided. The microwave outdoor transmission unit may include the polarization device 10, and is configured to implement microwave horizontal polarization and/or vertical polarization.

**[0031]** According to another aspect of the embodiments of the present invention, a communications system is provided. The communications system includes the microwave outdoor transmission unit, where the microwave outdoor transmission unit utilizes an included polarization device 10 to implement microwave horizontal polarization and/or vertical polarization.

**[0032]** The foregoing descriptions are merely specific embodiments of the present invention, but are not intended to limit the protection scope of the present invention. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in the present invention shall fall within the protection scope of the present invention. Therefore, the protection scope of the present invention shall be subject to the protection scope of the appended claims.

## Claims

1. A polarization device used for a microwave outdoor transmission system, wherein the microwave outdoor transmission system comprises an antenna and an outdoor active device, and the polarization device comprises:

   a first polarization component, wherein the first polarization component is fixed, in a removable manner, onto the outdoor active device, so that a waveguide of the first polarization component keeps staying in a same direction with a waveguide of the outdoor active device; and

   a second polarization component, wherein the second polarization component is fixed, in a removable manner, onto the first polarization component, so as to allow an included angle between a waveguide of the second polarization component and the waveguide of the first polarization component to be adjusted through rotation of the second polarization component in relation to the first polarization component.

2. The polarization device according to claim 1, wherein:

   the first polarization component comprises a cylindrical pipe, the cylindrical pipe has a closed end and an open end, the waveguide of the first polarization component is arranged in a center of the closed end of the cylindrical pipe, the closed end of the cylindrical pipe has a flange part, and the first polarization component is fixed, by using a fastener, onto the outdoor active device through a fastener hole on the flange part; and

   the second polarization component comprises a cylinder, the waveguide of the second polarization component threads through the cylinder and is arranged in a center of the cylinder, and the second polarization component is fixed onto the first polarization component through a fastener hole that is arranged around the cylinder.

3. The polarization device according to claim 2, wherein:

   an arc groove is arranged on an inner side of the closed end of the cylindrical pipe of the first polarization component, wherein the arc groove is concentric to the cylindrical pipe; and

   a bulge is arranged on one end surface of the second polarization component, wherein the bulge of the second polarization component is configured to slide in the arc groove of the first polarization component when the first polarization component cooperates with the second polarization component, so as to adjust the included angle between the waveguide of the second polarization component and the waveguide of the first polarization component.

4. The polarization device according to claim 3, wherein:

   the fastener hole on the cylinder of the second polarization component comprises an arc hole

concentric to the cylinder, so that when the bulge of the second polarization component slides in the arc groove of the first polarization component, a fastener used to fix the first polarization component with the second polarization component slides in the arc hole.

**5.** The polarization device according to claim 3 or 4, wherein:

a span of the arc groove of the first polarization component is at least 45 degrees.

**6.** The polarization device according to claim 4 or 5, wherein:

a span of the arc hole of the second polarization component is at least 45 degrees.

**7.** The polarization device according to any one of claims 4 to 6, wherein:

the second polarization component comprises at least one arc hole.

**8.** The polarization device according to any one of claims 1 to 7, wherein:

the polarization device further comprises a sealing ring, wherein the sealing ring is arranged on the inner side of the closed end of the cylindrical pipe of the first polarization component, and located around the waveguide of the first polarization component, so that sealing is formed between the first polarization component and the second polarization component when the first polarization component cooperates with the second polarization component.

**9.** A microwave outdoor transmission unit, comprising the polarization device according to any one of claims 1 to 8.

**10.** A communications system, comprising the microwave outdoor transmission unit according to claim 9.

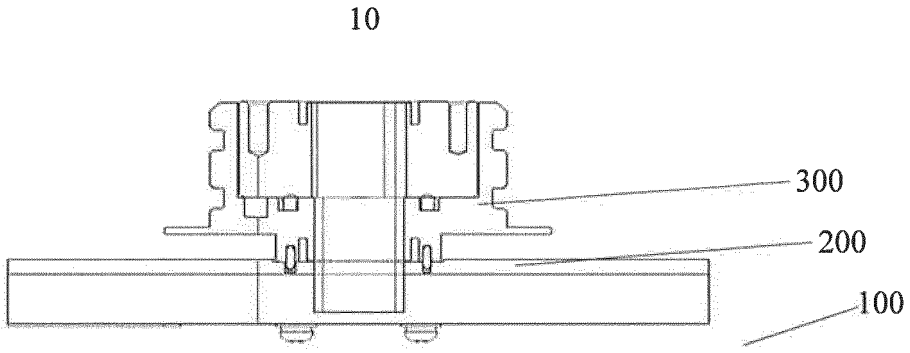


FIG. 1

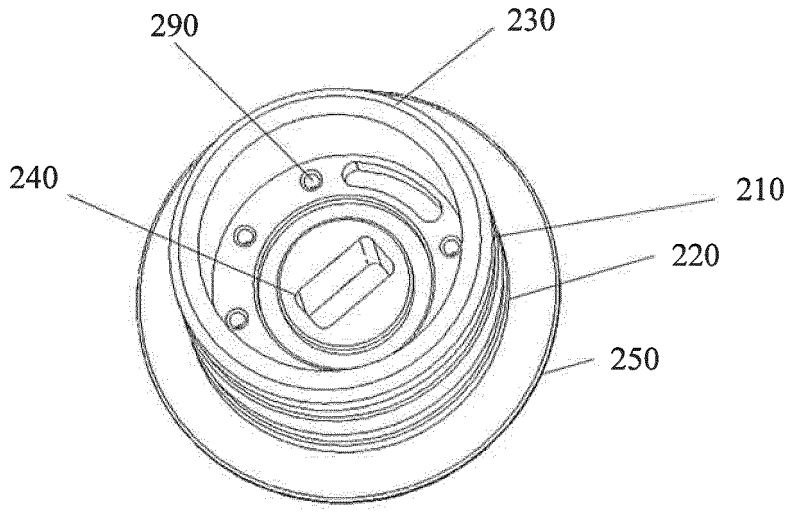


FIG. 2

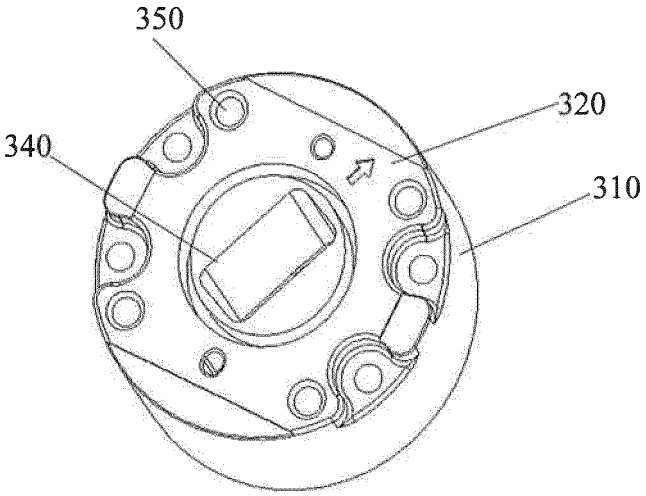


FIG. 3

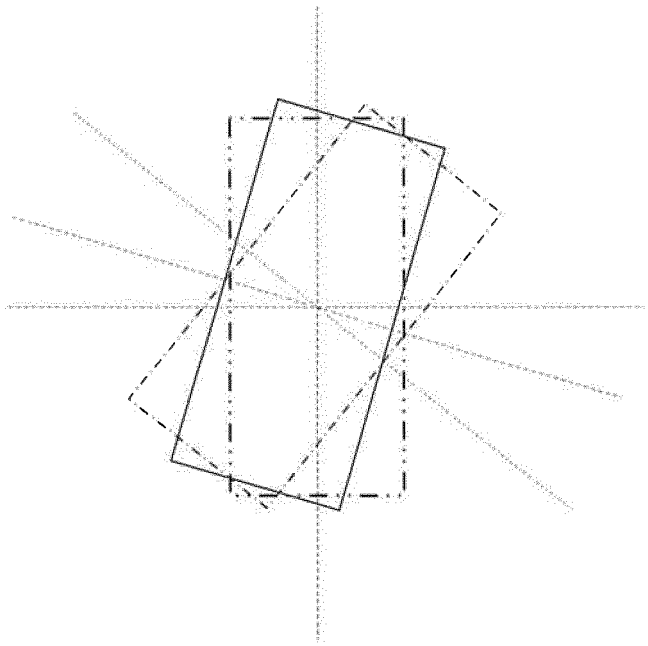

FIG. 4

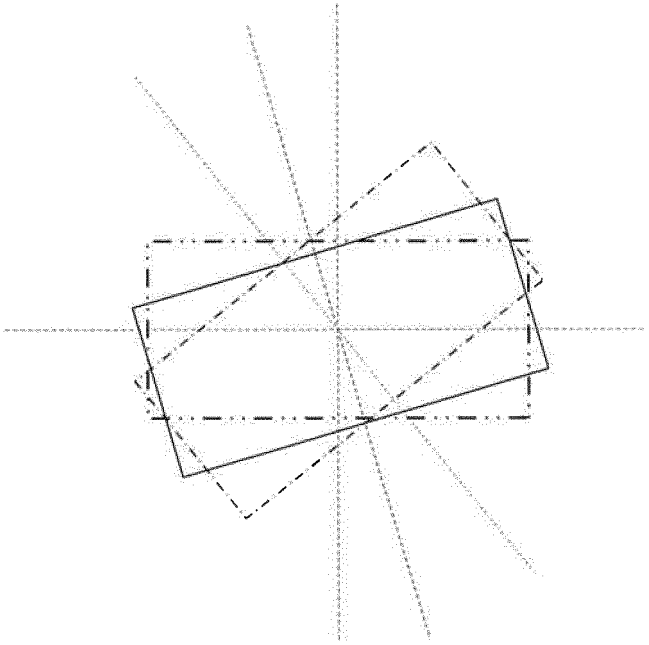

FIG. 5

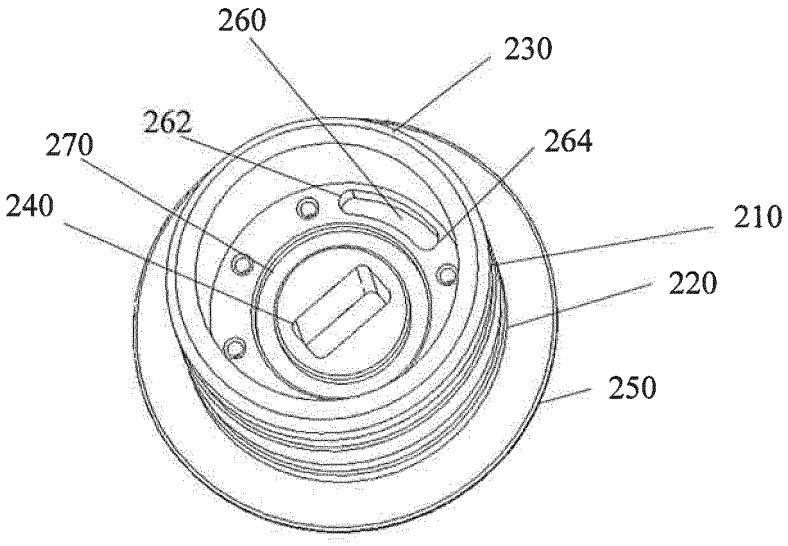


FIG. 6

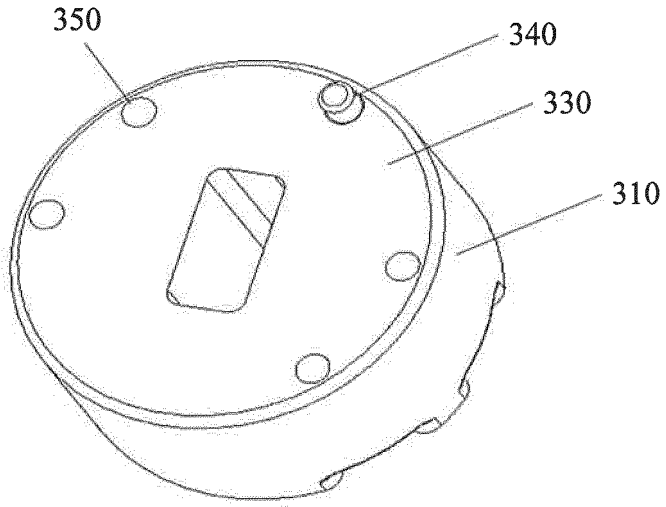


FIG. 7

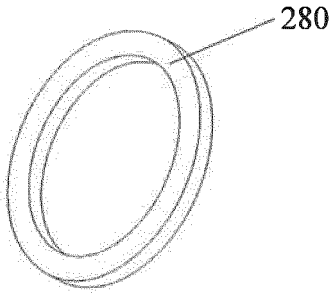


FIG. 8

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2012/087617**

**A. CLASSIFICATION OF SUBJECT MATTER**

H01Q 15/24 (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)

IPC: H01P; 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)

CNABS; CNTXT: polarization, antenna, rotate, waveguide, angle, slot

VEN: polar+, antenna, rotat+, waveguide, angle, slot

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| PX | CN 102496785 A (HUAWEI TECHNOLOGIES CO., LTD.), 13 June 2012 (13.06.2012), claims 1-10, and figures 1-8 | 1-10 |
| PX | CN 202384502 U (HUAWEI TECHNOLOGIES CO., LTD.), 15 August 2012 (15.08.2012), claims 1-10, and figures 1-8 | 1-10 |
| X | US 7053849 B1 (ANDREW CORP.), 30 May 2006 (30.05.2006), claim 1, description, paragraphs 0004-0023, and figures 1-6 | 1-10 |
| A | US 4260961 A (LICENTIA GMBH), 07 April 1981 (07.04.1981), the whole document | 1-10 |
| A | CN 1484340 A (RADIO FREQUENCY SYSTEMS, INC.), 24 March 2004 (24.03.2004), the whole document | 1-10 |

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
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| Name and mailing address of the ISA/CN:<br>State Intellectual Property Office of the P. R. China<br>No. 6, Xitucheng Road, Jimenqiao<br>Haidian District, Beijing 100088, China<br>Facsimile No.: (86-10) 62019451 | Authorized officer<br>**ZHANG, Xi**<br>Telephone No.: (86-10) **62411531** |

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Information on patent family members

International application No.
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