【DESCRIPTION】

【Invention Title】

AXIALLY DISPLACED ELLIPSE ANTENNA SYSTEM USING HELIX FEED FOR DUAL POLARIZATION

【Technical Field】

The present invention relates to an axially displaced ellipse antenna system for transmission and reception, and more specifically, to an axially displaced ellipse antenna system using a helix feed for dual polarization that can achieve a bidirectional communication with a satellite by forming a feeder into the helix feed for dual polarization capable of transmitting and receiving radios and exciting the transmitted and received radios by the helix feed, in the axially displaced ellipse (ADE) having a parabola dish, a reflector, and the feeder.

【Background Art】

A conventional ADE satellite antenna for transmitting and receiving a satellite frequency band signal of a C-band generally uses a parabola dish having a diameter of 1.2 m or more and installs a feed horn at a focal position at which radios reflected from the parabola dish are collected in a prime focus scheme or a Cassgrain scheme, thereby transmitting

and receiving satellite signals.

Since the C-band satellite antenna using the prime focus scheme or Cassgrain scheme uses the relatively low frequency band of the satellite signal of 3.42 GHz to 6.725 GHz, it needs a large-sized antenna having a high gain so as to smooth satellite communication.

In recent years, a communication scheme, such as a code division multiple access (CDMA) scheme, has been introduced into the satellite communication, such that the bidirectional communication can be achieved using the parabola dish having a relatively smaller size than the conventional antenna even in the C-band.

However, in order to apply the antenna according to the prime focus scheme or Cassgrain scheme having a relatively smaller size than the conventional antenna to the C-band antenna, the large-sized feed horn is needed. In other words, the size of the feed horn is large in a low frequency band rather than in a high frequency band and therefore, a problem in that the size of the feed horn becomes large in the C-band satellite antenna using the low frequency band occurs.

Also, when the bidirectional communication is performed using the feed horn, a polarizer for forming desired polarization and an orthogonal mode transducer for separating the polarizations in the transmitting and receiving bands

should be provided separately, such that the problems in that the installation process is complicated and the expense is very heavy occur.

【Disclosure】

【Technical Problem】

The present invention proposes to solve the above problems. An object of the present invention provides an axially displaced ellipse (ADE) antenna system using a helix feed for dual polarization in which the ADE antenna includes the helix feed for dual polarization for transmission and reception capable of processing satellite signals in a transmitting band and a receiving band, respectively, to be able to be used as an antenna for both transmission and reception, such that a feeder can be manufactured in a small size and in which the helix feed performs a role of a polarizer and an orthogonal mode transducer such that the polarizer and the orthogonal mode transducer are not needed separately.

【Technical Solution】

To achieve the above objects, the present invention provides an axially displaced ellipse (ADE) antenna system using a helix feed for dual polarization comprising: an

antenna radiator that includes a parabola dish in a parabolic form transmitting and receiving satellite signals, a reflector installed to correspond to a central axis of the parabola dish and reflecting the satellite signals, a helix feeder for dual polarization including a helix feed for reception receiving the satellite signals reflected through the parabola dish and the reflector and a helix feed for transmission radiating the satellite signal for transmission to the reflector, and a fixing member for feeder installed at the center of the parabola dish and fixedly coupling the helix feeder; and an antenna supporting bracket that supports the antenna radiator.

The helix feed for reception and the helix feed for transmission of the helix feeder are configured to include a cylindrical helix body for reception whose helix conducting wires are inclinedly wound outside the helix feed for reception and a cylindrical helix body for transmission whose helix conducting wires are inclinedly wound outside the helix feed for transmission and is fixedly coupled to the helix ground plate that is coupled to one end of the fixing member for feeder, the helix body for transmission being installed inside the helix body for reception.

Preferably, the end of the helix conducting wires in the reflector direction, which are wound to the helix body for reception and the helix body for transmission, is helically

wound to be smaller than a diameter of the helix body for reception and the helix body for transmission so as to make the wavelengths of the satellite signals uniform and improve an axial ratio.

Furthermore, the inside of the fixing member for feeder is provided with a low noise amplifier (LNA) that low noise-amplifies the satellite signals transmitted from the helix feed for reception and the antenna supporting bracket is provided with a low noise block (LNB) down converter that converts the low noise-amplified satellite signals transmitted from the LNA into satellite signals having an intermediate frequency band and a block up converter (BUC) that transmits satellite signals for transmission to the helix feed for transmission.

Also, the inside of the fixing member for feeder may be provided with the LNB that receives the satellite signals transmitted from the helix feed for reception and converts them into the intermediate frequency satellite signals or the BUC that transmits the satellite signals for transmission to the helix feed for transmission.

【Advantageous Effects】

The axially displaced ellipse (ADE) antenna system using a helix feed for dual polarization according to the present

invention has an effect that can simply manufacture the configuration of the antenna system by processing all the satellite receiving signals and the satellite transmitting signals having different frequency bands using the feeder to which the helix feed for reception and the helix feed for transmission are coupled.

Further, the axially displaced ellipse (ADE) antenna system using a helix feed for dual polarization has an effect that can improve isolation between a transmission port and a reception port, an axial ratio for each frequency band, and impedance characteristic by controlling an interval between the helix feeder and the reflector and the diameter, turn number, turn interval, etc., of the helix feed, such that the antenna system is mounted on mobile objects such as a ship or vehicles to smooth the bidirectional communication with the satellite even during the movement.

【Description of Drawings】

The above and other objects, features and advantages of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of an ADE antenna system using a helix feed for dual polarization according to the

present invention;

FIG. 2 is a side view of the ADE antenna system using a helix feed for dual polarization according to the present invention;

FIG. 3 is an enlarged cross-sectional view of an antenna radiator of the ADE antenna system using a helix feed for dual polarization according to the present invention;

FIG. 4 is a conceptual view showing an operational principle of the ADE antenna system according to the present invention;

FIG. 5 is an exploded side view of a helix feeder according to the present invention;

FIG. 6 is a side view of the helix feeder according to the present invention; and

FIG. 7 is a plan view of the helix feeder according to the present invention.

[Detailed Description of Main Elements]

10: antenna radiator 20: antenna supporting bracket

100: parabola dish 200: reflector

210: reflector supporting stand 300: helix feeder

310: helix feed for reception

311: helix body for reception

312: helix conducting wire 313: fixing plate

320: helix feed for transmission

321: helix body for transmission

321a: groove line

322: helix conducting wire

330: fixing ring

340: helix ground plate

341: receiving port

342: transmitting port

345: coaxial cable

400: fixing member for feeder

410: Low Noise Amplifier (LNA)

500: Low Noise Block (LNB) down converter

600: Block Up Converter (BUC)

【Best Mode】

Hereinafter, the embodiments of the present invention will be described in detail with reference to accompanying drawings.

FIG. 1 is a perspective view of an ADE antenna system using a helix feed for dual polarization according to the present invention, FIG. 2 is a side view of the ADE antenna system using a helix feed for dual polarization, and FIG. 3 is an enlarged cross-sectional view of an antenna radiator of the ADE antenna system using a helix feed for dual polarization.

As shown in FIGS. 1 to 3, the ADE antenna system using a

helix feed for dual polarization is configured to include an antenna radiator 10 that transmits and receives satellite signals and an antenna supporting bracket 20 that supports the antenna radiator 10.

The antenna radiator 10 includes a parabola dish 100 that transmits and receives the satellite signals, a reflector 200 that reflects the transmitted and received satellite signals, a helix feeder 300 that receives the satellite signals reflected through the reflector 200 or transmits the satellite signals for transmission to the reflector 200, a fixing member for feeder 400 that spaces and fixes the helix feeder 300 by a predetermined distance from the parabola dish 100, and a low noise amplifier (LNA) 410 that processes the satellite signals received through the helix feeder 300.

The parabola dish 100 and the reflector 200, which are a typical structure of the axially-displaced Ellipse (ADE) antenna having an axisymmetric structure, are manufactured in a small size and have high efficiency and low sidelobe characteristics.

FIG. 4 is a conceptual view showing an operational principle of the ADE antenna system according to the present invention.

As shown in FIG. 4, the central axis of the parabola dish 100, the reflector 200, and the helix feeder 300 conforms to

each other and the satellite signals received and reflected through the parabola dish 100 are secondarily reflected from the reflector 200 and transmitted to the helix feeder 300, and in contrast, the satellite signals radiated from the helix feeder 300 are reflected from the reflector 200 and transmitted to the parabola dish 100, which secondarily reflects the received satellite signals and transmits them to the satellite.

To this end, the parabola dish 100 is formed to have a curved surface capable of reflecting the satellite signals, wherein the curved surface is formed in a rotational form of a parabola whose axis is displaced from the central axis of the parabola dish 100 to form a focal point in a ring form in the reflector 200.

The reflector 200 is formed to have a central part of the reflecting surface that is protruded and an outer circumference that is formed in a curved surface having a concave shape, such that the satellite signals can be reflected. wherein the curved surface is formed in a rotational form of an ellipse whose axis is displaced from the central axis of the reflector 200, such that a focal ring is formed in the reflector 200 to conform to a focal ring of the parabola dish 100. The elliptical form of the curved surface of the reflector 200 is determined depending on the focal

point of the parabola dish 100 and a phase central distance of the helix feeder 300. Since the reflector 200 has an effect on the uniformity of the radiating surface electric field and the antenna efficiency, it is preferable that the reflector 200 is designed by appropriately controlling the focal point of the parabola dish 100 and the phase central distance of the helix feeder 300. The reflector 200 is fixedly coupled to the fixing member for feeder 400 and the reflector 200 to be fixedly installed at a front protruded reflector supporting stand 210, such that the central axis of the reflector 200 conforms to the central axis of the parabola dish 100.

The helix feeder 300 is configured to include a cylindrical helix feed for reception 310 and a cylindrical helix feed for transmission 320 installed inside the helix feed for reception 310.

FIG. 5 is an exploded side view of the helix feeder according to the present invention.

The helix feed for reception 310 is formed in a form that a helix conducting wire 312 of 1 mm is wound to a cylindrical helix body for reception 311 along an inclined line groove formed outside the cylindrical helix body for reception 311.

At this time, the diameter of the cylindrical helix body for reception 311 and a turn number and a turn interval of the helix conducting wire 312 maintain the diameter, turn number,

and turn interval that are required in designing the conventional helix antenna. In the embodiment of the present invention, the helix conducting wire 312, which is wound outside the helix body for reception 311 of the helix feed for reception 310, is wound clockwise.

One end of the helix body for reception 311 is formed in a ring form and the other end thereof is protrudedly formed with a fixing plate 313. The helix body for reception 311 is coupled through a circular helix ground plate 340 and a fixing ring 330 that are coupled to one end of the fixing member for feeder 400. The fixing ring 330 is formed with grooves to be able to receive the fixing plate 313 formed in the other end of the helix body for reception 311 and fix it, such that the helix body for reception 311 is firmly fixed to the helix ground plate 340. The helix conducting wire 312 of the helix feed for reception 310 is connected to a receiving port 341 that is installed at the helix ground plate 340.

The helix feed for transmission 320 is also configured in a form that a helix conducting wire 322 of 1 mm is wound to a cylindrical helix body for reception 311 along an inclined line groove formed outside the cylindrical helix body for transmission 321. At this time, the diameter of the cylindrical helix body for transmission 321 is formed to be smaller than the diameter of the helix body for reception 311

so that the cylindrical helix body for transmission 321 can be inserted inside the helix body for reception 311. Further, the inclined direction of the helix conducting wire 322 wound to the helix body for transmission 321 is formed in an opposite direction so that it is symmetrical with the inclined direction of the helix conducting wire 312 wound to the helix body for reception 311. In the embodiment of the present invention, the helix conducting wire 322, which is wound outside the helix body for transmission 321 of the helix feed for transmission 320, is wound counter-clockwise.

One end of the helix body for transmission 321 is formed in a ring form and the other end thereof is coupled to the other end of the helix body for reception 311 or the helix ground plate 340. The helix conducting wire 322 of the helix feed for transmission 320 is connected to a transmitting port 342 that is installed at the helix ground plate 340.

The inside of the fixing member for feeder is provided with an LNA 410, wherein the LNA 410 receives the satellite signals from the helix feed for reception 310 through the receiving port 341 installed at the helix ground plate 340, reduces the noise components of the satellite signals and amplifies the satellite signals, and transmits the amplified satellite signals to a low noise block (LNB) down converter 500 installed at the antenna supporting bracket 20 through a

50 Ω coaxial cable 345. Meanwhile, the transmitting port 342 instal led at the helix ground plate 340 transmits the satellite signals transmitted from a block up converter (BUC) 600 to the helix feed for transmission 320 through the 50 Ω coaxial cable 345.

The LNB 500 installed at the antenna supporting bracket 20 is an apparatus that converts the low noise-amplified satellite signals transmitted from the LNA 410 through the coaxial cable 345 into the intermediate frequency band and transmits them to the controller, and the BUC 600 is an apparatus that converts the signals to be transmitted to the satellite into the satellite signal frequency band for transmission and transmits them to the helix feed for transmission 320.

Although the above-mentioned embodiment of the present invention describes that the LNA 410 is installed inside of the fixing member for feeder 400 to which the helix feeder 300 is fixed and the LNB 500 and the BUC 600 are installed at the antenna supporting bracket 20, the installation position thereof can be appropriately changed. For example, the LNB 500 or the BUC 600 is selectively installed inside the fixing member for feeder 400 or both the LNB 500 and BUC 600 are installed inside the fixing member for feeder 400 so as to increase the space utilization, making it possible to reduce

the entire size of the antenna system. When the LNB 500 is installed inside the fixing member 400 for feeder, since the LNB 500 includes the function of the LNA 410, the installation of the LAN 410 can be omitted.

Meanwhile, the diameter of the helix feeds 310 and 20 is related to the design frequency and it is preferable that one-time turn circular constant (π) of the helix conducting wires 312 and 322 has 0.93 to 1 λ. Also, current flowing along the helix conducting wires 312 and 322 forms a progressive wave so that the helix feeds 310 and 322 can copy a good quality of circular polarization, the turn interval of the helix conducting wires 312 and 322, which serves as variables of a horizontal rotation angle has an effect on the horizontal direction progressing velocity of current to performs a role of controlling the phase of the circular polarization, and the turn length of the helix feeds 310 and 320, which is determined by the turn interval and turn number of the helix conducting wires 312 and 322, performs an important role of determining the antenna gain. Since the current intensity near a feeding portion of the helix feeds 310 and 320 is strong, the change in impedance is largely affected according to the interval between the helix ground plate 340 and the helix conducting wires 312 and 322. Also, the interference between the helix feed for transmission 320 and the helix feed

for reception 310, which are positioned inside the helix feed for reception 310, occurs according to the intensity and phase of current flowing along the helix conducting wires 312 and 322 of the helix feeds 310 and 320, which affects the isolation. As a result, in order to reduce the interference between the helix feed for reception 310 and the helix feed for transmission 320 , it is preferable to minimize the interference by controlling the turn interval of the helix conducting wires 312 and 322.

To this end, in the embodiment of the present invention, the diameter of the circular helix ground plate 340 is formed at 65 mm, the diameter of the body 311 of the helix feed for reception 310 coupled to the circular helix ground plate 340 is formed at 32 mm, and the turn number of the helix conducting wire 312 is 4.5 times and the turn interval thereof is formed at 14 mm. In addition, the diameter of the body 321 of the helix feed for transmission 320 positioned inside the helix feed for reception 310 is formed at 14 mm and the turn number of the helix conducting wire 322 is 7.5 times and the turn interval thereof is formed at 7 mm.

As described above, the diameter, turn number, and turn interval of the helix feed 310 for reception and the helix feed for transmission 320 have an effect on the isolation between the receiving port 341 and the transmitting port 342,

the axial ratio characteristic for each frequency, and the impedance matching according to the conditions of the design variables and thus, they should be sufficiently considered.

Therefore, it is preferable to appropriately control the design variables in consideration of the antenna gain where the isolation between the respective ports is considered, the axial ratio characteristic for each frequency, and the impedance matching.

FIG. 6 is a side view of the helix feeder according to the present invention and FIG. 7 is a plan view of the helix feeder according to the present invention.

In the case of the helix feeder 300 for dual polarization where the helix feed for transmission 320 is installed inside the helix feed for reception 310, the performance of the helix feeder 300 depends on the axial ratio indicating the equal ratio of the entire polarization of the satellite signals and a shielding effect between the transmitting and receiving signals. In particularly, in the case of the helix feeder 300 for dual polarization, the axial ratio is affected by a direction from the end of the helix feed or transmission 320 and the helix feed for reception 310 in the reflector 200 direction to a 1/4 point of the wavelength of the satellite signal.

As shown in FIGS. 5 to 7, in the embodiment of the

present invention, the end of the helix conducting wires 312 and 322 in the reflector 200 direction, which are wound to the helix body for reception 311 and the helix body for transmission 321, is helically wound to be smaller than the diameter of the helix body for reception 311 and the helix body for transmission 321 and is then finished, making it possible to make the wavelengths of the satellite signals uniform, improve an axial ratio, and increase the shielding effect between the transmitting and receiving signals.

Meanwhile, in FIG. 5, after the helix body for reception 311 and the helix body for transmission 321 are separately manufactured, they are each coupled to the helix ground plate 340 so that the helix body for transmission 321 is positioned inside the helix body 311 for reception. As shown in FIGS. 6 and 7, the helix body for reception 310 and the helix body for transmission 320 may be integrally manufactured to be coupled to the helix ground plate 340.

As such, the helix body for reception 311 and the helix body for transmission 321 according to the embodiment of the present invention may be manufactured in various forms such that the helix body for transmission 321 is positioned inside the helix body for reception 311.

As described above, the ADE antenna system using the helix feed for dual polarization is provided to be able to

transmit and receive the satellite signals through the helix feeder 300 that includes the helix feed for reception 310 and the helix feed for transmission 320.

The ADE antenna system according to the present invention is mounted on the mobile objects such as vehicles or a ship, such that it can be used as the satellite antenna system mounted on the mobile objects that transmits and receives the satellite signals while tracking the position of the satellite and as the fixing satellite antenna system that is installed at a fixed point and transmits and receives the satellite signals. Further, the ADE antenna system is used in a state where the outside of the ADE antenna system is covered with a cap for protecting or in some cases, may be of course used in a state where the cap is removed.

Those skilled in the art will appreciate that the conceptions and specific embodiments disclosed in the foregoing description may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present invention. Those skilled in the art will also appreciate that such equivalent embodiments do not depart from the spirit and scope of the invention as set forth in the appended claims.

【CLAIMS】

【Claim 1】

An axially displaced ellipse (ADE) antenna system using a helix feed for dual polarization comprising:

an antenna radiator 10 that includes a parabola dish 100 in a parabolic form transmitting and receiving satellite signals, a reflector 200 installed to correspond to a central axis of the parabola dish 100 and reflecting the satellite signals, a helix feed 300 for dual polarization including a helix feed for reception 300 receiving the satellite signals reflected through the parabola dish and the reflector and a helix feed for transmission 320 radiating the satellite signal for transmission to the reflector 200, and a fixing member for feeder 400 installed at the center of the parabola dish 100 and fixedly coupling the helix feeder 300; and

an antenna supporting bracket 20 that supports the antenna radiator 10.

【Claim 2】

The ADE antenna system according to claim 1, wherein the helix feed for reception 310 and the helix feed for transmission 320 of the helix feeder 300 are configured to include a cylindrical helix body for reception 311 and a cylindrical helix body for transmission 311 whose helix conducting wires 312 are inclinedly wound outside the helix

feed for reception 310 and a cylindrical helix body 321 for transmission whose helix conducting wires 322 are inclinedly wound outside the helix feed for transmission 312 and is fixedly coupled to the helix ground plate 340 that is coupled to one end of the fixing member for feeder 400 and the helix body for transmission 321 is installed inside the helix body for reception 311.

【Claim 3】

The ADE antenna system according to claim 2, wherein the end of the helix conducting wires 312 and 322 in the reflector 200 direction, which are wound to the helix body for reception 311 and the helix body for transmission 321, is helically wound to be smaller than a diameter of the helix body for reception 311 and the helix body for transmission 321 so as to make the wavelengths of the satellite signals uniform and improve an axial ratio.

【Claim 4】

The ADE antenna system according to claim 1, wherein the inside of the fixing member for feeder 400 is provided with a low noise amplifier (LNA) 410 that low noise-amplifies the satellite signals transmitted from the helix feed for reception 310 and

the antenna supporting bracket 20 is provided with a low noise block (LNB) 500 down converter that converts the low

noise-amplified satellite signals transmitted from the LNA 410 into satellite signals having an intermediate frequency band and a block up converter (BUC) 600 that transmits satellite signals for transmission to the helix feed for transmission 320.

【Claim 5】

The ADE antenna system according to claim 1, wherein the inside of the fixing member for feeder 400 is provided with the LNB 500 that receives the satellite signals transmitted from the helix feed for reception 310 and converts them into the intermediate frequency satellite signals or the BUC 600 that transmits the satellite signals for transmission to the helix feed for transmission 320.