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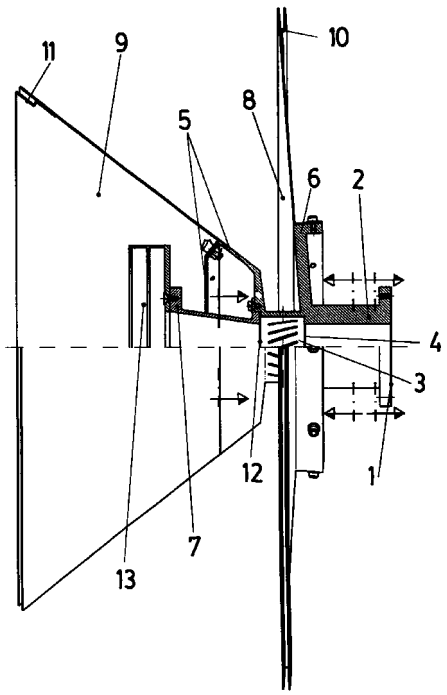
(54) Dish-type isoflux antenna

(57) Antenna with weight and dimensions below that of other antenna employed for low orbit artificial satellites, characterized by an asymmetrical double conical structure (8 and 9); radiating between its two conical plates (8 and 9) by means of grooves made in a resonating cavity (3), the antenna additionally presenting a corrugated horn (13) which completes an isoflux radiation diagram.

FIG.1



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Description

OBJECT OF THE INVENTION

[0001] The invention which is herewith defended consists of a shaped beam antenna (technically called of isoflux), from among the isoflux antenna for low orbit satellites.

[0002] It made up of two radiating elements: an asymmetrical double cone, and a circular horn, the radiated power is distributed by means of a resonating cavity. The cavity transmits power to the circular horn through a first coupling plate, by means of a conical guide section, and to the double cone through vertical or sloped grooves which charge the guide.

[0003] Said first coupling plate, either circular or of any type, shall be symmetrical as regards the two perpendicular axis.

[0004] The antenna operates in circular polarization. Due to this, it is fed by a circular or squared circular guide polarizer (the polarizer is not the object of the invention).

[0005] The asymmetrical double cone may have totally or partially smooth or corrugated interior walls, as well as an inclination angle.

BACKGROUND OF THE INVENTION

[0006] Isoflux antenna are known as least since the decade if the 80's. However, the type of antenna used up to the present is based on the use of a reflector. This signifies an essentially different structure and principle from the one described herein.

[0007] The isoflux antenna which are known up to now are made up of a greatly shaped symmetrical reflector, fed by antenna of the horn type, supported either by a centred mast or else by lateral struts (in the slang of this industrial activity generally known as struts). This type of antenna has been used in the SPOT, ERSI satellites and is going to be used in the ENVISAT, of forthcoming launching.

[0008] The typical application of said antenna, as well as the one proposed by the invention, is for low orbit satellites (typically below 1.500 Km) for the spreading of data over the surface of the earth.

[0009] The advantage offered by the invention lies in a notable reduction in the size and weight of the antenna (key characteristics when dealing with space equipments). Likewise, it is considered that the cost of the same shall be very inferior to that of the reflector.

[0010] The applicant has no knowledge of the existence of asymmetrical double conical antenna, fed by means of sloped grooves performed in a circular resonating cavity, coupled to a cylindrical horn placed at the symmetry axis of the double cone, all this providing circular polarization.

DESCRIPTION

[0011] The invention which is the object of the present specification refers to an antenna which emits waves with circular polarization. The entrance of the antenna is made of a guide of circular waves.

[0012] This guide is connected to a cylindrical cavity, resonating cavity, through a second coupling plate with a symmetrical opening according to two perpendicular axis. The resonating cavity presents a series of equally spaced grooves on the side walls, in a number over four. The grooves have an appropriate inclination in order to achieve a radiation in circular polarization.

[0013] The resonating cavity is connected to three elements which form part of the antenna. On one hand, it is connected to the circular guide by means of the second coupling plate which presents a symmetrical hole according to two perpendicular axis. It is additionally connected to an asymmetrical double cone structure, through the previously indicated side grooves. And finally, to a circular antenna of the horn type through the first coupling plate, which joins it to a conical guide section.

[0014] The inclination angle of the double cones is the appropriate one to achieve the beam shape. The surface of the double cones may be smooth or corrugated, depending on the specification imposed on the radiation diagram.

[0015] The antenna of the horn type offers a diagram which fills the central part (around the symmetry axis), completing the lateral contribution of the double cone structure, so that the totally desired diagram is achieved.

[0016] The dimensions of the conical or circular guide are such, that the phases of the diagrams of the double cone structure and the antenna of the horn type are the appropriate ones in order to meet the specifications of coverage.

[0017] The indicated elements may be manufactured in various parts which are screwed to each other by means of flanged unions.

[0018] The assembly offers a radiation diagram which has a maximum at the coverage edge (between 45" and 70° of the symmetry axis), and the gain of which is reduced as the angle closes towards the symmetry axis, with a minimum axial and azimuthal ripple.

[0019] The assembly has a polarizer connected at the entrance which provides a signal with circular polarization. This polarizer may be of any type of the ones already known, and does not form part of the invention.

[0020] At the entrance of the guide with circular section which feeds the assembly, a third coupling plate is to be found.

[0021] The three coupling plates fulfill the mission of the adaptation of impedances to achieve a maximum power transmission. The first, from the resonating cavity to the conical wave guide, the second from the circular guide to the resonating cavity, and the third, from the

polarizer, to all the assembly of the antenna.

[0022] It is pointed out that the three described plates comply with the symmetry requirement according to the perpendicular axis, and that any of them could be used in the position of the others according to the requirements of the project.

DESCRIPTION OF THE DRAWINGS

[0023]

Figure 1 is a cross sectioned view of the dish-type isoflux antenna, internally showing a possible embodiment, with the different elements joined by means of screws.

Figure 2 presents a view of the embodiment of the third plate, present at the entrance of the antenna.

Figure 3 corresponds to a view of an embodiment of the second plate, placed at the entrance to the cylindrical cavity with grooves.

Figure 4 corresponds to a view of an embodiment of the first coupling plate, the one which serves for the connection of the cylindrical cavity with the circular conical wave guide.

PREFERRED EMBODIMENT

[0024] The invention which is herewith defended, consists of a dish-type isoflux antenna, from among the isoflux antenna for low orbit satellites.

[0025] The antenna is fed by a polarizer (not included in any of the figures) which is adapted, for a maximum delivery of power, to the entrance of the antenna. This polarizer is not the object of the present invention.

[0026] At the entrance of the antenna, considered in general assembly, a coupling plate (1) is to be found, which connects the polarizer with the circular wave guide (2). The circular wave guide (2) has an appropriate diameter so that only the dominant TE_{11} mode, in circular guide, can be spread. The circular guide (2) is joined on the same piece to a cylindrical resonating cavity (3), which presents 16 sloped grooves. The cylindrical cavity (3) is completely open at an upper end. The circular guide (2) and the cylindrical cavity (3) are connected to each other by means of a coupling plate (4), with an opening in the shape of a cross (4.1). In this preferred example, said plate (4) forms, with the resonating cavity (3) and the wave guide (2), a single piece. The dimensions of the cross (4.1), together with the opening (1.1) of the plate (1), are as appropriate, for the correct adaptation of the antenna.

[0027] The length of the circular wave guide (2) is also determined for the appropriate adaptation of the antenna.

[0028] The coupling plate (1) is a different piece, 0.5 mm thick, with a centred circular opening, and holes which coincide with those of the flange of the guide (2).

[0029] Two double conical structures are machined on the piece which forms guide (2), plate (4), and resonating cavity (3): an upper double conical structure (5), which has two flared angles, and the lower double conical structure (6) which present one single angle. Both structures are finished off in flanges with suitable holes for their union with the conical plates (8) and (9). The entrance of the guide (2) is also a flange with holes, for their union to the piece (1) and to the polarizer. On its upper part, the guide (2) has also various holes, between 4 and 6, for their union to the conical wave guide (7).

[0030] The conical plate (8) has a circular flange on its central part for its union by means of screws to the guide (2) by means of the double conical structure (6). On its outer end, it carries a ring (10) with a "Z" shaped section, which is bonded, forming a ring technically named as "chock".

[0031] The conical plate (9) also presents a circular flange on its central part for its union by means of screws to the guide (2), by means of the upper double conical structure (5). Likewise, at an outer end, it carries a bonded ring (11), one section in "Z" shape, which also forms a chock.

[0032] The two conical plates (8) and (9) form an asymmetrical double conical structure.

[0033] The dimensions and angles of the conical plates (8), (9), and their corresponding rings (10) and (11), as well as their connection to each other, with the double conical structures (5) and (6), are appropriate to achieve the desired radiation diagram.

[0034] The coupling plate (12) presents a thickness of 0.5 mm, is externally circular and has an opening in the shape of a cross (12.1) at its symmetry axis (figure 4), and the holes for their union to the upper part of the resonating cavity (3).

[0035] The conical wave guide (7) has flanges at both ends. At their lower end it is connected to the resonating cavity (3), enclosing the phase sifting element (12) between both.

[0036] At the upper zone of the conical wave guide (7), it is attached by means of screws to the corrugated horn (13). The diameters and length of the conical wave guide (7) are attached to achieve that the diagram phase radiated by the conical plates (8) and (9) and the horn (13) be appropriate. Additionally, the dimensions of the coupling plate (12) are attached so that the radiation between the conical plates (8) and (9) and the horn (13) be adequate in power and phase in order to obtain the desired diagram.

[0037] The horn (13) is a cylindrical structure with two or more corrugations, screwed to the conical wave guide (7) by means of countersunk screws.

[0038] All the assembly has symmetry of revolution, excluding the sloped grooves.

[0039] Alternatively, the coupling plate (12) can be

substituted or complemented by a phase shifting element constituted by means of circular guide sections.

[0040] This description is not made more extensive with the understanding that any expert in the art shall have sufficient information to understand the scope of the invention and the advantages derived, as well as the manner of reproducing the same.

[0041] It is understood, that if the essentiality of the invention is not altered, both the variations in the materials as well as the shape, the size and the arrangement of the elements are capable of variation characterized within the same.

[0042] The terms used during the description and the meaning of the same, shall always be considered in a non limitative manner.

Claims

1. Dish-type isoflux antenna, from among the isoflux antenna, essentially characterized in that it is made up of an asymmetrical double conical structure (8) and (9), fed by grooves made on the resonating cavity (3), by a circular guide (2); and by a horn (13) centred at the rotation axis of the asymmetrical structure (8) and (9).

2. Dish-type isoflux antenna, according to the previous claim, characterized in that it is provided with a resonating cavity (3), charged by sloped grooves, for the circular polarization at the double conical structure (8 and 9).

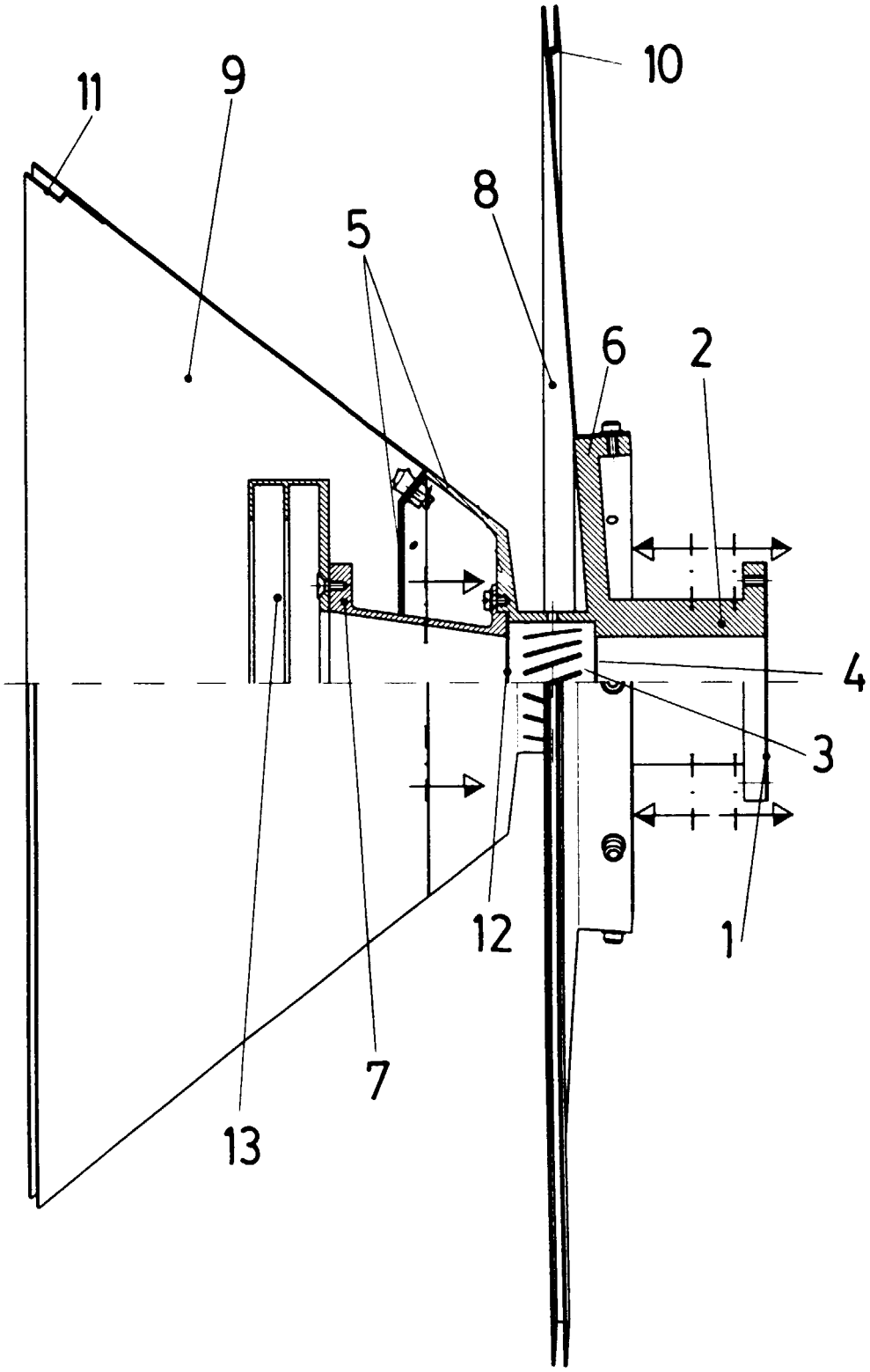
3. Dish-type isoflux antenna, according to the previous claims, characterized in that it is provided with a coupling plate (12) between the resonating cavity (3) and the conical wave guide (2); which determines the power radiated between the lower conical plate (8) and the upper conical plate (9), on one hand, and the corrugated horn (13), on the other.

4. Dish-type isoflux antenna, according to the previous claims, characterized in that the wave guide (7) placed between the resonating cavity (3) and the horn (13) centred at the axis, achieves the appropriate phase from the diagrams radiated by the double conical structure (8 and 9) and the horn (13) centered at the axis.

5. Dish-type isoflux antenna, according to the fourth claim, characterized in that, by means of circular guide sections, alternative or complementary to the coupling plate, the appropriate phase from the diagrams radiated by the double conical structure (8 and 9) and the horn (13) centred at the axis, can be achieved.

6. Dish-type isoflux antenna, according to the5 previous claims, characterized in that the selection of the angles of the double conical structure (8 and 9) permit the establishment of the direction of the radiation maximums.

FIG. 1



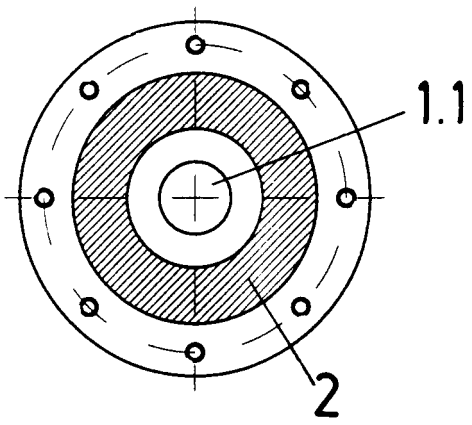


FIG.2

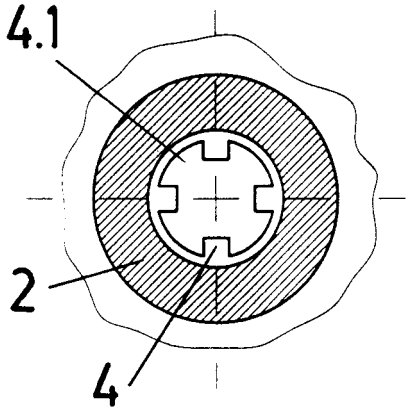


FIG.3

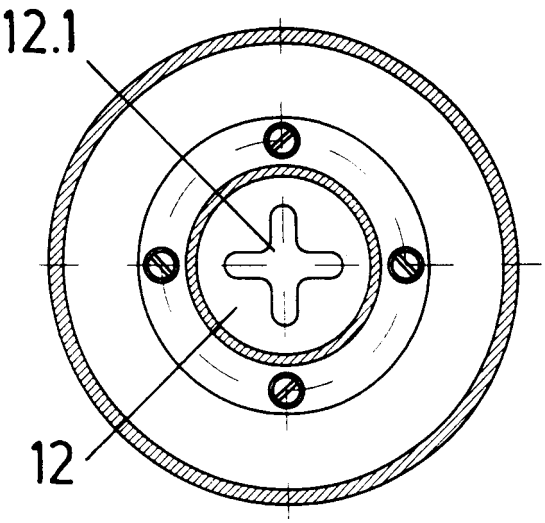


FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 98 50 0187

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	US 3 568 203 A (VENTERS) 2 March 1971 * column 2, line 26 - line 63 * * column 3, line 24 - column 4, line 47; figures 2A,B *	1,2 3-6	H01Q13/04 H01Q21/29
Y	MONSER ET AL.: "Omnidirectional K-Band Antenna Uses Slots, Probes and Horns" ELECTRONICS, vol. 34, 18 August 1961, pages 54-55, XP002090154 NEW YORK US * page 54; figures 1,2 *	1,2	
Y	EP 0 456 034 A (HUGHES AIRCRAFT) 13 November 1991 * column 4, line 51 - column 5, line 8; figures 1,3,8 *	1	
A	US 4 143 377 A (SALVAT ET AL.) 6 March 1979 * column 2, line 13 - line 43; figures 1-3 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01Q
A	ROTH H ET AL: "FUNDAMENTAL DESIGN ASPECTS FOR THE DEVELOPMENT OF A HIGHLY SHAPED ANTENNA AND BREADBOARD MEASUREMENTS" EUROPEAN CONFERENCE ON SATELLITE COMMUNICATIONS, MANCHESTER, NOV. 2 - 4, 1993, no. CONF. 3, 2 November 1993, pages 399-403, XP000458044 INSTITUTION OF ELECTRICAL ENGINEERS * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 January 1999	Angrabeit, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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