(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 670 609 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **95830068.3**

(51) Int. Cl.[6] : **H01Q 19/17**

(22) Date of filing : **01.03.95**

(30) Priority : **03.03.94 IT RM940117**

(43) Date of publication of application :
06.09.95 Bulletin 95/36

(84) Designated Contracting States :
BE DE ES FR GB IT NL

(71) Applicant : **SPACE ENGINEERING S.p.A.**
Via dei Berio, 91
I-00155 Roma (IT)

(72) Inventor : **Lori, Maurizio**
P.zza dei Gerani 16A
I-00172 Rome (IT)
Inventor : **Russo, Pasquale**
Via C. Massini 102
I-00175 Rome (IT)

(74) Representative : **Perrotta, Luciana, Dr.**
c/o D. Perrotta & C. S.a.s.,
Corso Vittorio Emanuele II, 21
I-00186 Roma (IT)

(54) Multibeam antenna capable of receiving/transmitting same frequency signals, from/to one or more coplanar directions, simultaneously.

(57) Multibeam antenna capable of receiving/transmitting signals at the same frequency, in one or more directions, simultaneously, essentially consisting of one or more radiating elements (2), of a parabolic reflector (1) with square-shaped edge (3), being one of the four vertices (4) of the square which circumscribes the reflector (1) located close to the focal axis of the paraboloid. The radiating elements (2) and, correspondingly, the operating directions, are aligned along one of two possible orthogonal planes. The invention provides, with respect to previous solutions : maximum isolation between operating directions, at the same antenna gain ; minimum size of the reflecting surface, since the rectangular shape reduces the overall dimensions and makes packaging - and therefore transportation - easier. Techno-scientific scope : space and non space antenna electronics ; field of application : space antennas to be used especially for TV signals.

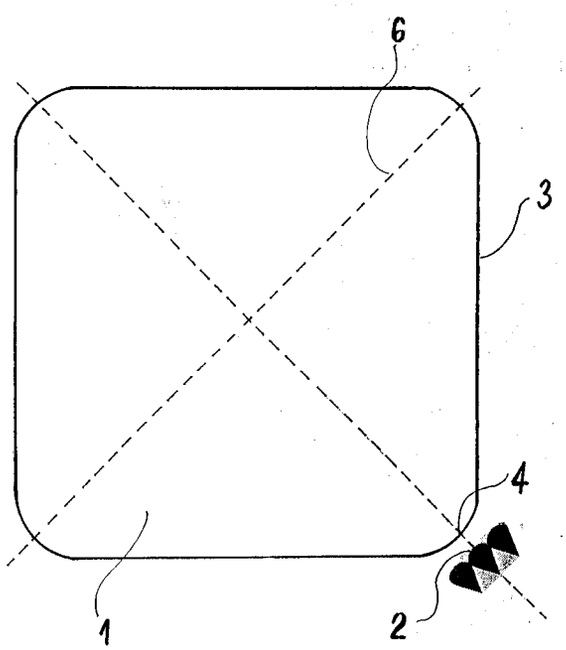

Fig. 1

EP 0 670 609 A1

This invention concerns a multibeam antenna capable of receiving/transmitting same frequency signals from/to one or more coplanar directions simultaneously.

The invention consists of one or more radiating elements and of a parabolic reflector with square aperture. Essential detail for the achievement of optimal performance is that one of the four vertices of the square, which circumscribes the reflector, must be placed close to the vertex of the paraboloid. A more detailed explanation will be provided later on herein.

With this invention the Inventors intend to meet the need of obtaining an antenna capable of simultaneously receiving/transmitting signals at the same frequency, from/to several coplanar directions, while ensuring at the same time a sufficient degree of isolation between signals, in the case that these directions are aligned and in proximity one with the other.

The successful results which the owner Company wishes to patent were reached in the attempt to respond to future demands in the via satellite reception of TV signals. Due to the increase in the crowding of the stationary orbit, one will soon receive signals from a satellite while trying at the same time to filter as much as possible the signals coming from adjacent satellites. The attenuation of these disturbing signals is necessary because, since they occupy the same frequency band as those one wishes to receive, they are noise.

In the previous techniques, the same problem was solved by using oversized reflectors. This system often met only partially the needs mentioned above, since it provided not simultaneous reception of these signals through a resighting mechanism. This implied technical problems as well as, obviously, greater costs.

This invention finds its application in the technical field of space and non-space antenna electronics. It may be conveniently applied especially in the field of space antennas, most of all for TV signals.

The invention subject of this application for patent refers to an antenna studied for Direct Broadcasting System (DBS) type applications, namely a direct TV signal reception system via satellite.

The invention illustrated herein ensures, in case of "single reflector" configuration adoption, the achievement of optimal performance in terms of:

- maximum isolation between operating directions, at the same antenna gain;
- minimum size of the reflecting surface - in fact, the square configuration allows to reduce packaging problems and therefore facilitates antenna assembly transportation.

The invention will now be described by way of illustration and not in a limiting manner, according to the version currently preferred by the inventors and referred to the figures attached hereto:

Fig. 1 - Schematic drawing of the plan view of the antenna reflector

Fig. 2 - Schematic drawing of the side view of the antenna reflector

Fig. 3 - Assembly of the plan view a), of the side view b) and of front view c)

Fig. 4 - Schematic drawing of the radiation patterns of the antenna.

As regards Fig. 4, notice how, at the peak of each one of the three beams, the directivity of the other two is very low.

Fig. 1 shows one of the aperture shapes, of reflector (1), which can be assigned to the antenna in question, in which (3) indicates the rim, (4) indicates one of the four vertices close to which passes the focal axis (5). The focal axis is visible in Fig. 2, while in Fig. 1 it coincides with point (2). The radiating elements (2) and the optimal operating directions (represented by the diagonals (6) of the reflector) are coplanar and can be placed on two orthogonal planes.

The antenna, subject of the invention submitted herein, has therefore been studied, as mentioned before, for DBS type applications and in particular it meets the requirements the parameters of which are illustratively indicated by, but not limited to, the following:

- angular distance between generated beams = 3.3°
- projected square surface area < 800 x 800 mm^2
- total isolation from adjacent satellites (copolar and crosspolar polarisation) and within the same satellite (crosspolar) > 27 dB.

The antenna receives the TV signal coming from continguous satellites on the stationary orbit. The angular distance, which today is expected for these satellites, is about 3.3°. The Inventors have taken this requisite into account in their invention.

The electro-magnetic energy coming from each satellite is reflected by the reflector's surface and directed towards the corresponding radiating element (2).

The most significant result of the invention is represented by the capacity of not receiving unwanted signals coming from other directions. Essentially, this considerable advantage is due to the fact that the antenna has a square configuration and it is used in directions aligned with the diagonals.

It is possible to exploit the actually greater width of the aperture in those directions and a greater power tapering at the ends. These two characteristics, once combined, cause very low side lobes.

Claims

1.) Multibeam antenna, featuring a square-shaped aperture configuration and parabolic surface, capable of receiving/transmitting signals at the same frequency, in one or more directions, simultaneously.

2.) Antenna as per Claim No. 1, in which the radiating elements (2) (in order to achieve optimal performance) are placed on the focal plane and interaligned, according to the direction defined by the reflector's (1) plane of mirror simmetry.

3.) Antenna, as per Claims No. 1 and 2, in which the radiating elements (2) must lay on the focal plane and must be interaligned according to a direction perpendicular to the reflector's plane of mirror simmetry.

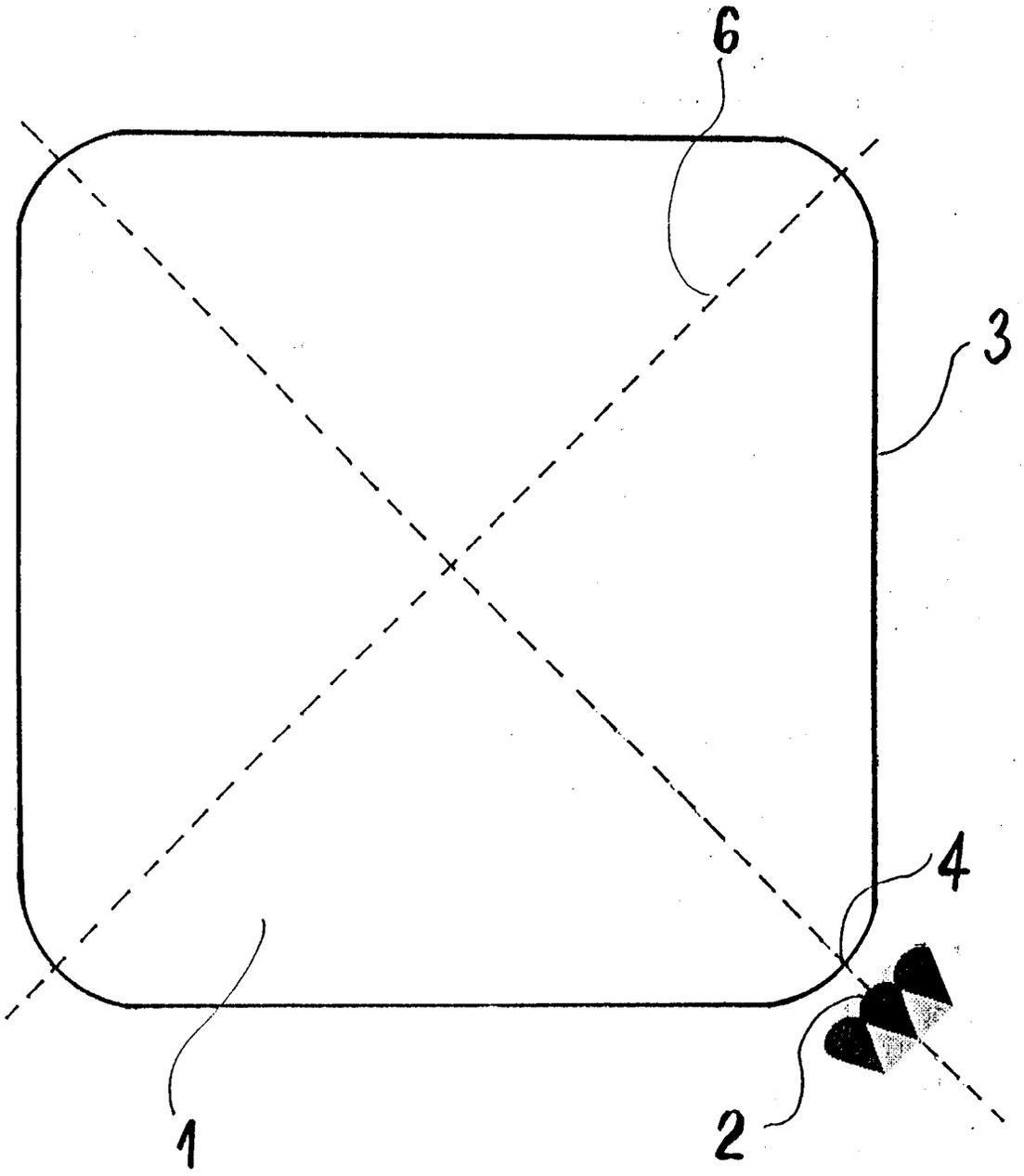

Fig. 1

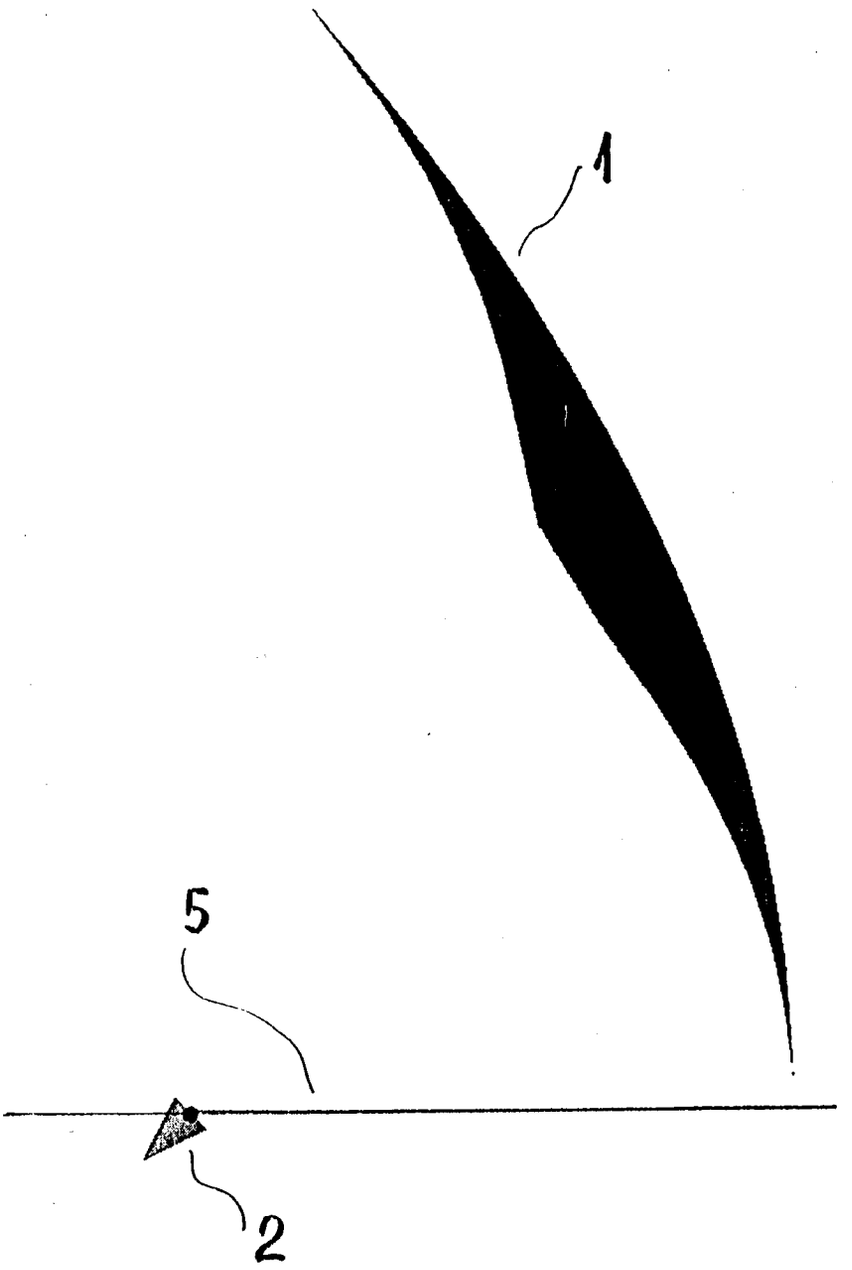

Fig. 2

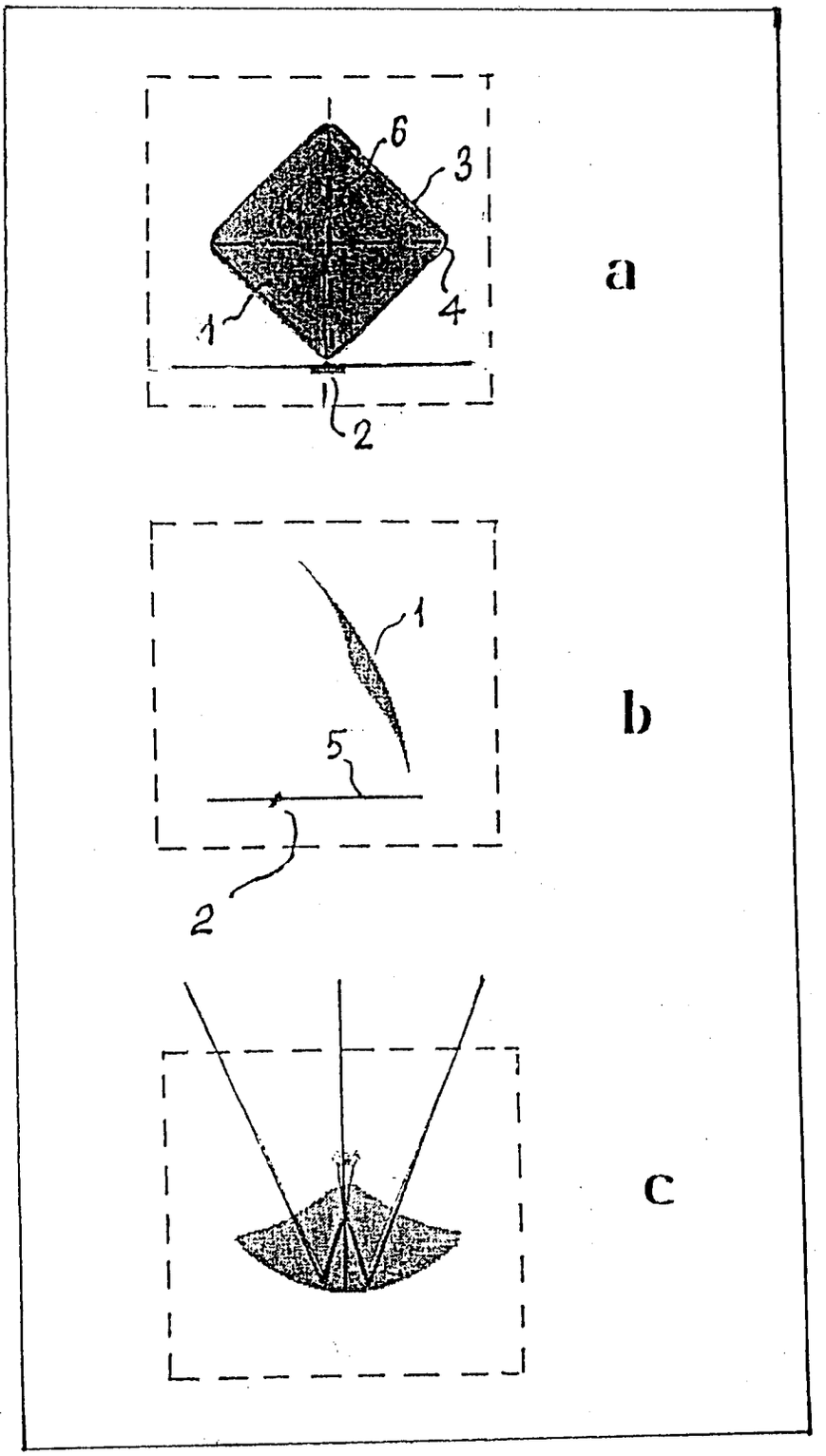

Fig. 3

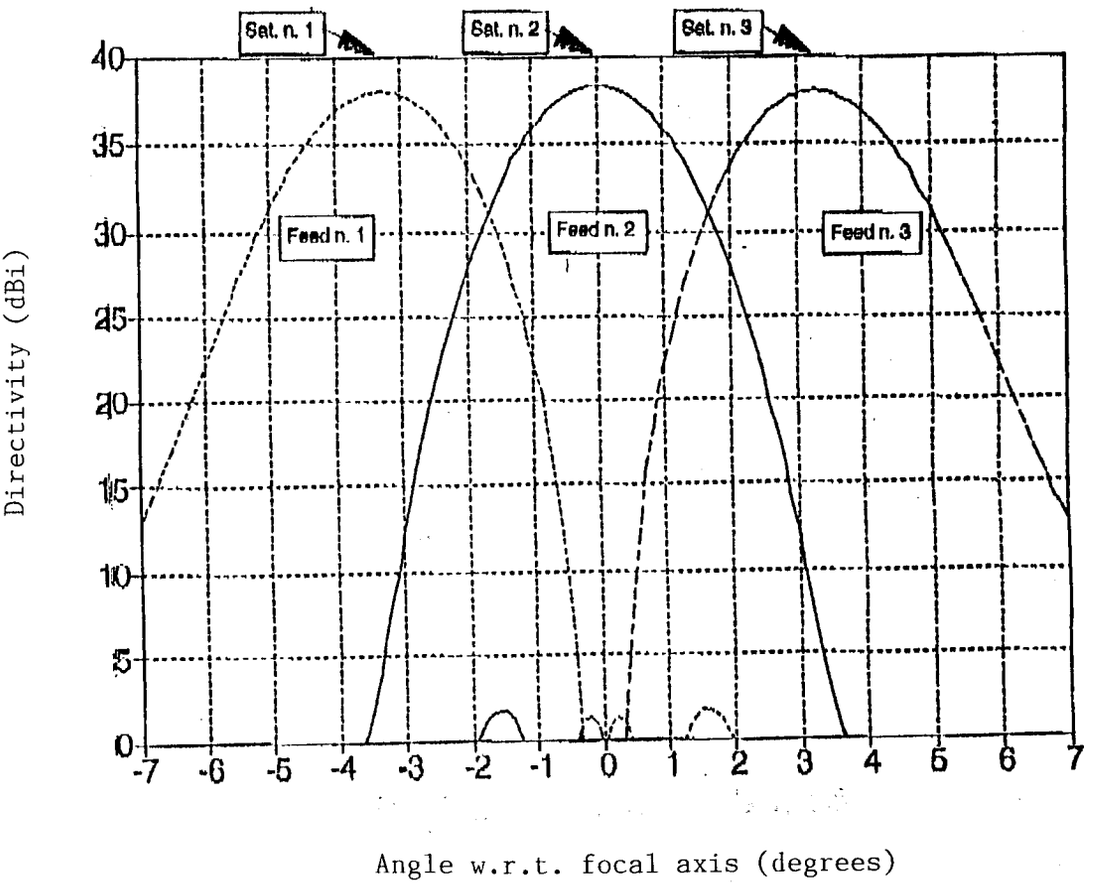
Set. n. 1
Set. n. 2
Set. n. 3
Feed n. 1
Feed n. 2
Feed n. 3
40
35
30
25
20
15
10
5
0
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
Directivity (dBi)
Angle w.r.t. focal axis (degrees)

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 83 0068

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)
X	WO-A-92 07394 (D-MAC INTERNATIONAL) * page 4, line 16 - page 5, line 32; figure 5 *	1-3	H01Q19/17
X	FR-A-2 674 377 (ALCATEL ESPACE) * page 3, line 13 - page 5, line 8; figures 1-3 *	1	
A	EP-A-0 275 062 (NEC) * claims 1-4; figures 2,3,5 *	1-3	
A	DE-A-36 05 195 (LICENTIA) * figure 3 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 June 1995	Angrabeit, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)