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DE ES FR GB NL SE(71) Applicant: **ALENIA AERITALIA & SELENIA S.P.A.**
Via Tiburtina, Km. 12,400
I-00131 Roma(IT)(72) Inventor: **Lomaglio, Francesco Saverio**
Via C.G.Bertero 49
I-00156 Roma(IT)
Inventor: **Ascione, Giancarlo**
Viale Dante Alighieri 154
I-03043 Cassino(IT)(74) Representative: **Gustorf, Gerhard, Dipl.-Ing.**
Patentanwalt Dipl.-Ing. Gerhard Gustorf
Bachstrasse 6 A
W-8300 Landshut(DE)(54) **Device which improves the efficiency of a radiating system by means of parasite elements set on the ground plane.**

(57) The invention regards a device which improves the efficiency of a radiating system by means of parasite elements formed on the ground plane, which consist of half-wavelength dipoles (active elements) (1) and four indirectly fed slots (2) (parasite elements), where these slots are excited by the active elements, which are connected to a supply line (4). The scope of the device is to control the radiating pattern of a dipole array through the slots (2).

The invention pertains to the field of antennae, and more precisely to that of microwave antennae. It may be adopted in stand-alone or in integrated applications on reflector antennae for air traffic control, where detection is performed in the S band, associated with an interrogation performed in L band, obtained by inserting the innovative device into an existing feed so as to achieve a control over the radiating pattern of the entire radiating system or antenna, according to the application.

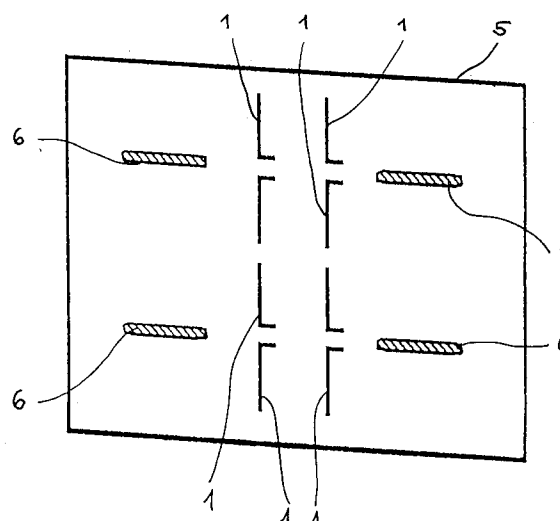


FIG.1

The invention regards a device to be inserted into an antenna feed, capable of improving the efficiency of the radiating system, and which is particularly suitable to achieve control on the radiating pattern of the entire system, according to its eventual application.

This is possible through the device described here, as once it is supplied directly by an RF source it excites a passive radiating element, i.e. not fed directly, consisting of a half-wavelength slot set on the same ground plane as the dipole.

The invention belongs to the technical field of antennae, and more precisely to microwave antennae, and it may be adopted in stand alone or integrated configurations for reflector antennae for air traffic control, where detection is required to be in the S band associated with an interrogation which has to be in the L band. Such interrogation can be obtained by inserting the innovative device into a possibly pre-existing illuminator which can control the radiating pattern of the entire radiating system or antenna.

The device exploits the parasite effect of radiating elements, which are electromagnetically complementary to active elements connected to a feed network. We refer to the case of electrical dipoles as active elements and magnetic dipoles as passive elements, consisting of slots in the ground plane.

The advantage obtained with this invention is that of securing the same radiating effectiveness of a radiating system of four elements fed through a suitable feed line, yet having less electrical losses due to the adoption of a simplified feed line, as it serves only the active elements of this configuration.

As far as is known to the inventors, such a device does not exist. Previously, devices of similar functionalities were mauded by heavy drawbacks, mostly related to the complexity of the radiating part and of the feed parts, resulting in greater electrical losses and considerable physical dimensions, such as to give way to shading or blocking effects on the main reflector.

To summarise, the advantages of this invention are the following:

- less electrical losses in the feed lines;
- smaller fascicle dimensions;
- less mechanical and electrical complexity;
- lower build and test costs;
- greater reliability;
- possible integration with pre-existing antennae.

The invention will now be described for illustrative non limiting purposes with reference to the tables of drawing attached.

Figure 1 is a schematic diagram of the radiating system. It shows:

- 1 active elements
- 5 ground plane
- 6 parasite elements (slots)

Figure 2 shows the lateral section view of the device. We can see:

- 1 active elements
- 5 ground plane
- 6 slots or parasite elements

Figure 3 shows the electrical diagram of the device. Here we can see:

- 1 active elements
- 2 Delta input port
- 3 Sigma input port
- 4 Feed line

Once more with reference to the figures attached, we shall now describe how the invention covered by this patent application actually works.

The radiating system, shown in figure 3, adopts the half-wavelength dipole as radiating element, obtained coaxially or by etching process on the ground plane.

Once directly and electrically fed, it excites a passive radiating element (by passive we intend an element which is not fed directly), such as the half-wavelength slot, set on the same ground plane as the dipole.

The slot has to be correctly positioned and oriented with respect to the active radiating element, according to the excitation required of the entire radiating system. Set in the centre of the dipole and orthogonally to it, it is subject to the maximum coupling to the dipole, with consequential maximum electromagnetic excitation. Therefore, by selecting the required number of active elements, or dipoles, and the number and position of the passive ones, or slots, it is possible to control the radiating pattern of the entire radiating system, or antenna, according to the application required.

The illustration of the principle of operation of the device can be made by thinking of the radiating system as two radiating elements and two passive elements set on the same ground plane as shown in figure 2.

From an electrical viewpoint, the system shown in figure 1 may be schematically thought of as two radiating active elements with a unit excitation, where parameter K is equal to 1, of their image with respect to the ground plane, also with unit excitation,, and of two parasite radiating elements, with excitation lower than that of the active elements ($K < 1$) as a function of their position.

Figure 2 shows the electrical schematic described and the global excitation function of the equivalent radiating system. The latter has a radiating effectiveness equivalent to that of a four element radiating system, but with lower electrical losses due to the adoption of a simplified electrical feed, which is limited to two central active elements

in the system.

As a conclusion, the array radiating pattern, due to the active dipoles, is controlled through the electromagnetic or air coupling between them and the slots set in the dipole ground plane.

The slots behave as equivalent radiating elements with phase and intensity excitation levels determined by the coupling, which is a function of the dimensions and relative position of the slots with respect to the active elements.

The simple variation of the geometric parameters and number of the slots, provides a function to excite the radiating system, which for the same number of radiating elements, is obtained with a substantially simplified feed network, of easy electric and mechanic integration in antennae for surveillance radars which also require an interrogation function.

The invention of this radiating system has an application to a reflector type antenna operating in the S band which also requires an L band interrogation function, which is obtained by integrating the new radiating system into the existing illuminator by means of an additional retrofit kit.

Claims

1. Device to improve the efficiency of a radiating system, consisting of a group of active elements (1) and parasite passive elements (6) on the ground plane (5).
2. Device to improve the effectiveness of a radiating system, as per claim 1, where the passive elements are excited by the active elements.
3. Device to improve the efficiency of a radiating system, where the device is configured in the manner presently preferred by the inventors, which may however adapt to other preferred geometric configurations.
4. Device to improve the efficiency of a radiating system as per claims above, which can be configured in different manners, such as periodic, non periodic, with variable period.
5. Device for the improvement of the efficiency of a radiating system, as per previous claims, which can be used in stand alone configuration as a radiating system or as an illuminator of a lens or of a reflector type antenna.
6. Device to improve the efficiency of a radiating system as per claims above, which finds its best application in the general field of antennae, and in particular in that of radar and telecommunications antennae.

7. Device for the improvement of the efficiency of a radiating system, as per previous claims, which in its best utilisation can be inserted in the complex system of a reflector type antenna.

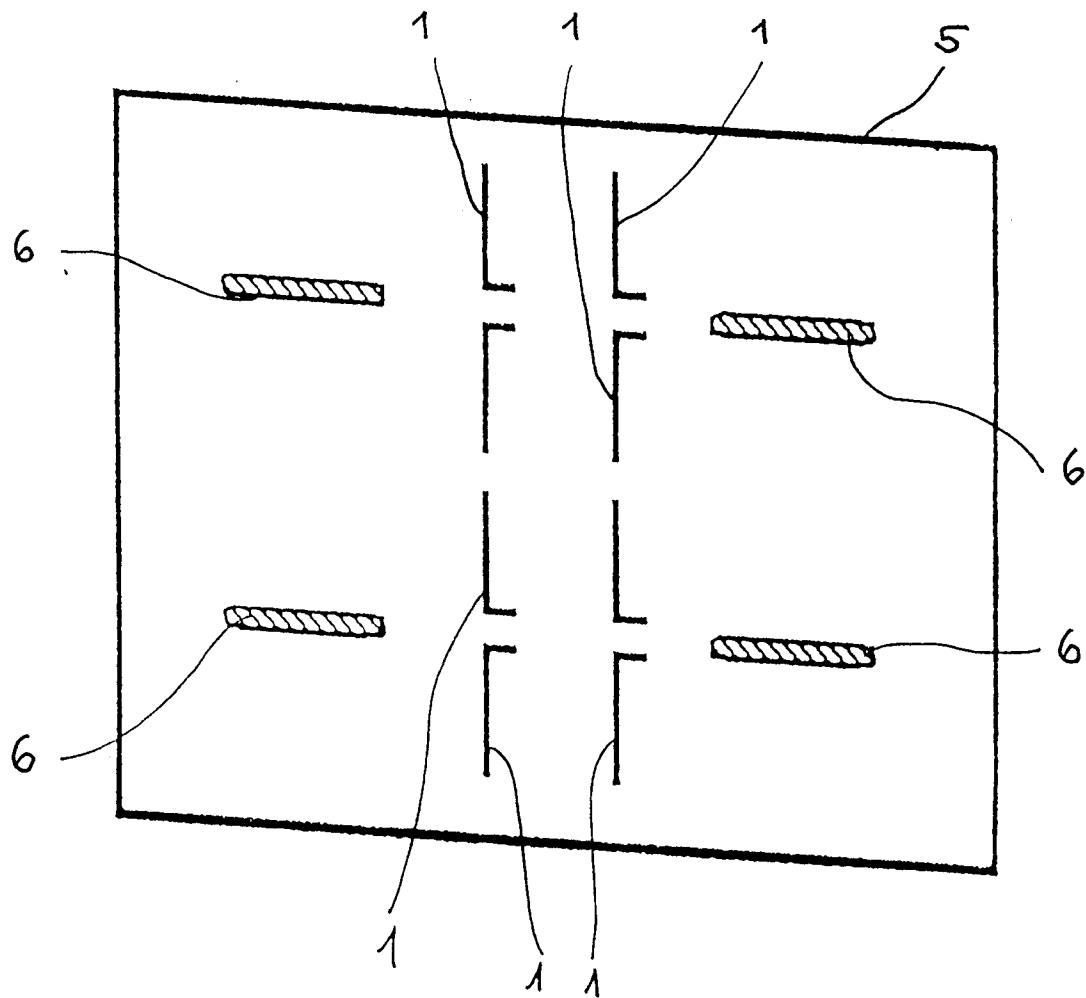


FIG.1

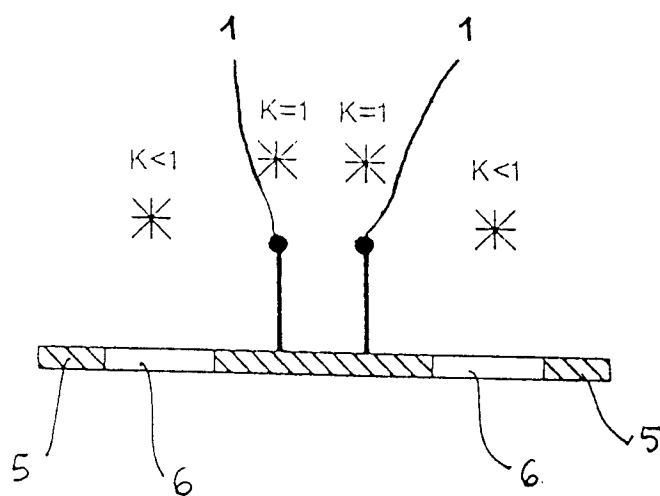


FIG. 2

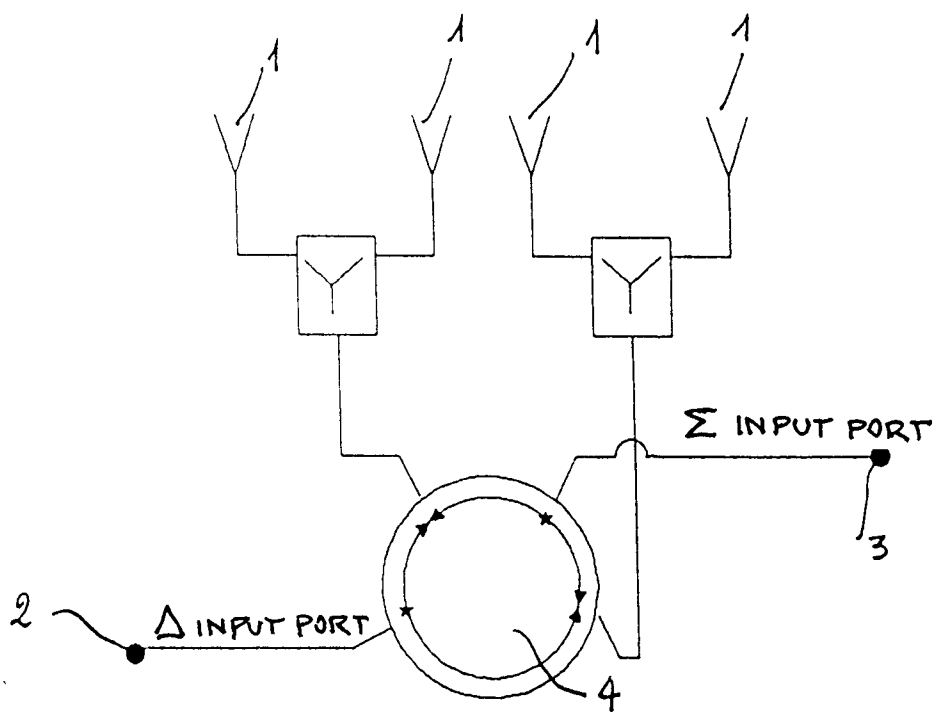


FIG. 3