

THE NEW METHOD OF ELECTRONIC SCANNING

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Abstract

We investigate the possibility of using the reversing mediums in the antenna engineering that gives us the ability to improve characteristics of the antenna systems; particularly we can receive the adjusted form and width of the directional diagram in the microwave range and we can also command the directional diagram while scanning within the adjusted rule.

Key words: scanning, reflector antenna, directional diagram, reversing medium.

1. INTRODUCTION

The antenna systems are integral parts of modern radio aids. They are used to define the direction for the evolving source or investigating positions of many evolving sources in the ambient space. Thus, the problem of operative scanning and manipulation of the directional diagram form is one of current importance for today. Accordingly, the antennas have turned into one of the determinant link of radio systems. They are not just the equipment for extension of the radio communication distance. The limit possibilities of the modern radio-locating stations, particularly, their radio communication distance, exactness of direction-finding and many other characteristics depend on technical conditions of antenna systems, above all they depend on the width of the directional diagram ray. Mechanical and electromechanical methods of scanning can not satisfy modern demands of round-up's speed and possibility of tracing for transference of many objects at the same time.

That's why we offer the method of electronic scanning of the directional diagrams of the reflector antennas which implies making the antenna reflector of reversing materials. The peculiarity of the reversing medium is that it is radioparent, but after experiencing the influence of the keying signal, it acquires the features of the reflective surface. [1,2].

2. METHOD OF ELECTRONIC SCANNING

We know that the structure of the energy spectrum is the main factor which determines the electroconductivity of some substances. Dielectrics have a wide forbidden gap, that's why transition of the electrons to the conducting band while the influence of the thermal excitation is impossible. Metals do not have the forbidden band. Semi-conductors have the forbidden band of 0.01 – 5 electronvolt in width.

When the temperature is low and the power supply is absent, the semi-conductor does not conduct current, i.e. it is an insulator. When energy is supplied from outside, for example, while heating a crystal, there appears the possibility of the electrons transfer from the valence band to the conducting band.

The insignificant amount of admixture added to the pure semi-conductor can dramatically increase its electroconductivity. Its nature changes while the temperature is growing. As a result, the electroconductivity takes on mixed nature. While the temperature is growing, impurity levels weaken. Finally, at the certain temperature the electrons transfer only from the valence band to the conducting one.

The increase of the admixture concentration in the semi-conductor decreases the size of the transition region between the impurity conductance and self-conductance. While the further increase of the admixture share, the energy of the active impurity center decreases. At some level of concentration it turns into zero, i.e. the semi-conductor becomes a semimetal. Such materials, when they experience low temperatures, show the features of metals; when the temperature is high, they show the features of dielectrics. Thus, the semi-conductor saturated with the admixtures can be used as the reversing medium which is conducted by the temperature [3].

We can see the similar effect when the semi-conductor is influenced by the light or electronic ray. While the constant temperature and absence of evolving, the electroconductivity of the pure semi-conductor or impure semi-conductor is called the dark conduction. After lighting the semi-conductor by some light with the energy of the photons, which is higher than the width of the forbidden gap of the pure semi-conductor or higher than ionization energy of the impure semi-conductor, the additional nonequilibrium carrier of the charge appears in the conducting band. As a result, the electroconductivity of the semi-conductor grows.

The appearance of the photo-carrier causes the local changes of all the electromagnetic parameters of the material, such as reflection, refraction and transmission coefficients of the electromagnetic wave. Under the absence of light, the reversing medium possesses the small dark illumination and it is the radioparent medium.

We offer the method of scanning, which is based on the lighting the surface of the reversing medium with the intensive light spot of the necessary size and shape. Changing this size leads to changing the width of the

directional diagram and its shape in the given plane. It is obvious that the width of the directional diagram of the antenna depends on the size, shape and orientation of the light spot, e.g. it becomes narrower with the growth of the light spot. During the transference of the light spot on the surface of the reflector, we implement scanning of the directional diagram in the space. At the same time, the speed of scanning is limited only by the transmission speed of the reversing medium from the non-conducting state to the conducting, i.e. it is determined by the life time of nonequilibrium carriers of current, and by the speed of the light spot transfer; the rule of shift of the light spot disposition, as well as the directional diagram, can be arbitrary.

Thus, this method both makes it possible to generate the directional diagram with the given form and width in the microwave range and to command the directional diagram while we are scanning, using the adjusted rule, that ensures the trajectory flexibility and the scanning high speed.

Semi-conducting material has to meet to some special demands including time lag, spectrum characteristics and mechanical properties. Moreover, it has to have the high amplitude and phase uniformity.

3. ANTENNA SYSTEMS WITH ELECTRONIC SCANNING

The method of scanning suggested is the base of functioning of some antenna systems such as the multibeam reflector antenna and the multibeam spherical reflector one. In these systems the changes of electrodynamic parameters of different regions of the reversing material occur with the help of the influence of command signals on the inside reflector surface, that makes possible scanning the directional diagram in the space.

3.1 MULTIBEAM REFLECTOR ANTENNA

The reflector of the multibeam reflector antenna is the inside surface of the rotation body of the parabolic generator around the axis that is perpendicular to the focal axis and which passes through the focus of parabola. The reflector is made of the radioparent material, but its inside surface is covered by the reversing material. The antenna system has a source of command signals. The antenna system provides the possibility of the feed elements moving along the focal axis that passes through the focus of parabola. The structural arrangement is pictured on the figure 1.

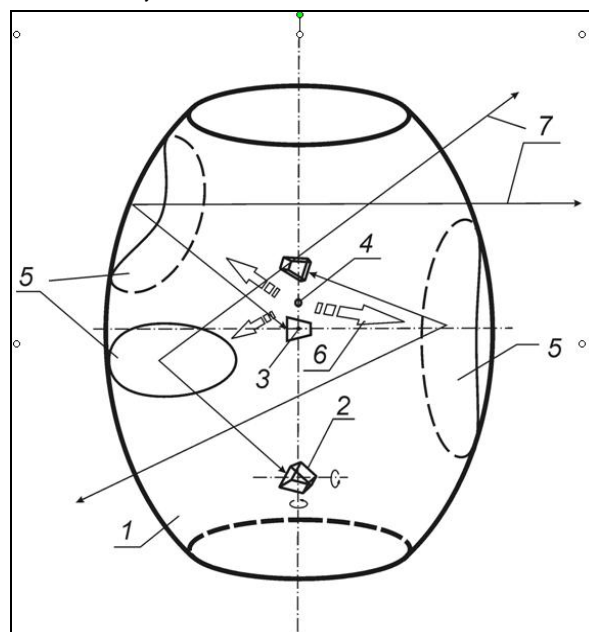


Fig. 1. Multibeam reflector antenna

The device functions in the following way. The feed elements 2 are moved along the axis that is perpendicular to the focal axis, and passes through the focus of parabola 3. The source of the command signals 4 influences on the surface of the reversing material in regions 5 with the help of signals 6 on the reflector 1. The reversing medium possesses small dark illumination in the nonexcited state that's why the reversing medium is radioparent in this state. The intensive light spot influences on the reversing material and in these regions of the reversing surface we can observe the sudden changes of all parameters of the reversing material. They are conditioned by generating the nonequilibrium carriers of current, which change the electromagnetic characteristics of the reversing material. Thus, the reversing material acquires metallic features that makes possible to reflect electromagnetic waves. That's why more than one ray of the directional diagram is formed.

We can change in turn the conductivity of different regions of the semi-conductor with the help of moving the spots of the command influence. As a result we have a circular scanning of the directional diagram rays in the space. The width of the directional diagram depends on size, form, and orientation of the excited regions.

Thus, the multibeam reflector antenna makes possible to form the multibeam directional diagram in the space with the circle scanning of the directional diagram rays [4].

This antenna system has some imperfections; particularly we can not make the spherical scanning of the directional diagram in the space. This imperfection is removed in the multibeam spherical reflector antenna.

3.2 MULTIBEAM SPHERICAL REFLECTOR ANTENNA

This antenna system has some imperfections; particularly we can not make the spherical scanning of the directional diagram in the space. This imperfection is removed in the multibeam spherical reflector antenna. The reflector of this antenna is formed with the help of rotation of the circle generator. At the expense of it the geometric form of the excited region of the reflector does not depend on the direction of influence of the command signal. That makes it possible to do the spherical scanning of the directional diagram rays in the space. Moreover, we can move the feed elements round the focal center sphere. The structural arrangement is pictured on the figure 2 [5].

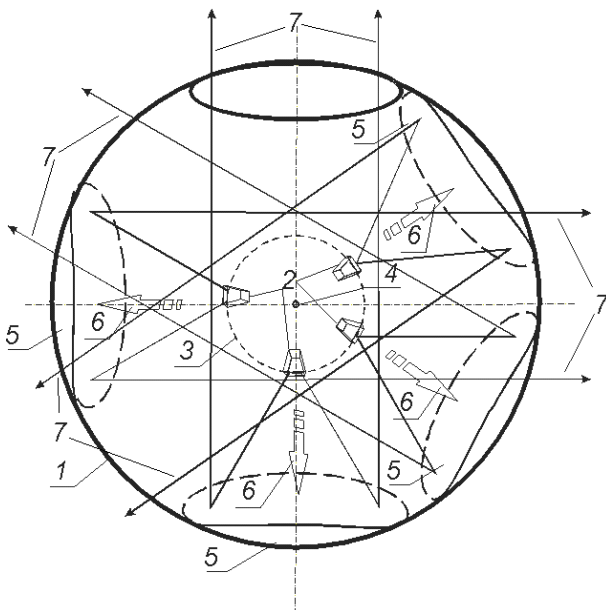


Fig. 2. Multibeam spherical reflector antenna

4. CONCLUSION

The method of electronic scanning offered in this article has some advantages which appreciably extend the possibilities of its further use that we can see in the offered models of the antenna systems. The further development of the antenna engineering will expect increasingly fast-acting and flexible systems with expanded functions of the data handling that can ensure only electronic scanning. The result of this investigation is the offered method of electronic scanning with the help of reversing mediums which can be used in the radio engineering complexes.

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