PhD Ritter D.V., Student Ritter E.S.

Manash Kozybayev North Kazakhstan university

Microwave energy concentrations on irradiated objects using waveguide vibrator grids

The distribution of power in the irradiated object should be as uniform as possible, unless special conditions are imposed. The use of a surface waveguide in the form of a single wire makes it possible to implement a number of solutions. Let's consider some of them. First of all, these are various arrays from a number of vibrators installed near the wire and excited by the waveguide field. The obvious advantage in this case is that the entire set of vibrators is not galvanically connected to a wire, which greatly simplifies the system of energy distribution among re-radiators. The lattice is a kind of panel with vibrators, near which a wire with a surface wave is placed. The length and width of the panel are determined by the irradiated object. The simplest option is a system of a number of vibrators installed near the wire in a certain way, depending on the required polarization of the emitted field and the field distribution. Figure 1 shows antenna arrays of various polarizations: from linear (a, b, c) to circular (d, e)

The options for constructing the gratings shown in Figure 1 are based on the structure of the field near the wire and the wavelength in it. Due to the phase change through half the wavelength in the wire, the gratings are also built accordingly. These variants have been experimentally investigated in a number of works [1,2].

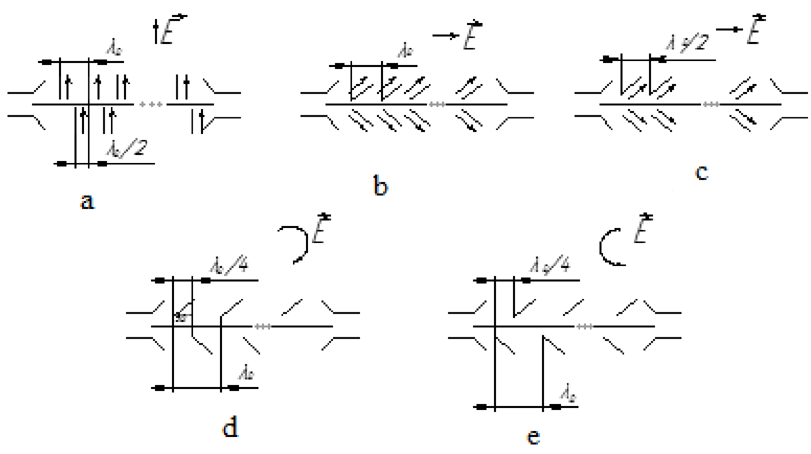

Figure 1. Options for constructing antenna arrays

As for the uniform distribution of the field along the lattice, this is determined by the coupling coefficient of the vibrators with the wire, which depends on the distance between them.

The power re-emitted by each vibrator can be recorded (we neglect the connection between vibrators):

$$P_N = P_0(1-k_1)(1-k_2)....(1-k_{N-1})k_N \qquad (1)$$

where P_0 is the power supplied to the waveguide, k_i is the coupling coefficient of the *i*-th vibrator with the wire. Since the vibrators are installed along the wire with a period, $d = \lambda_B$ then

$$(1-k_1)(1-k_2)...(1-k_{N-1})k_N = F(Nd) \qquad (2)$$

Where $F(Nd)$ is the distribution function of the coupling coefficients along the length of thewire.

The power of the vibrators should be distributed as much as possible, but the residual power will always be and it must be set. The balance equation in this case will have the form

$$\frac{P_0 - (P_1 + P_2 + ... + P_N)}{P_0} \le \xi \qquad (3)$$

For the field distributions, without taking into account the connection between the vibrators, expressions are obtained for the coefficients of the connection between the vibrators and the line. As for the distances between the surface of the waveguide wire and the end of the vibrator, it is advisable to use the experimental dependences of the re-emitted field level as a function of the distance [3]. The reference criterion should be the residual power.

In particular, taking into account the narrow frequency range allocated for microwave irradiation, an array in the form of zigzag periodic structures of conductors with a half-wavelength period is proposed. Such structures are placed perpendicular to the waveguide axis with a period equal to the wavelength in the waveguide. Antenna array is shown in Figure 2.

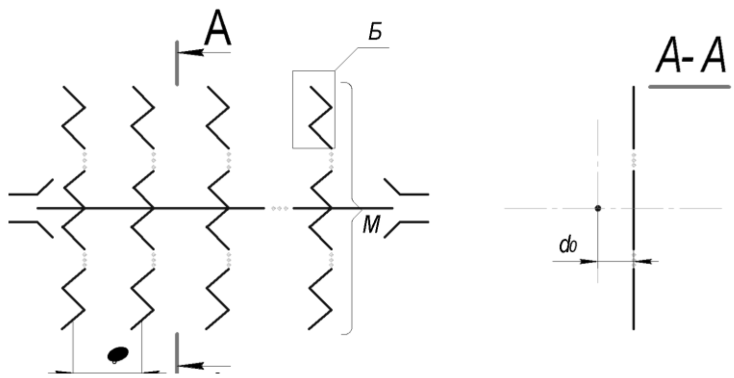

Figure 2. Antenna arrays of zigzag periodic structures

A feature of this antenna array is that each component of the zigzag structure is a half-wave re-emitter, the total effect of which is equivalent to a system of linear vibrators parallel to the wire axis with a distance equal to $1{,}41\frac{\lambda}{4}$. Vibrators are effectively excited at a distance. Such a system is equivalent to a transverse-radiating array of re-radiators. Here N is the number of zigzag structures, M is the number of bends in the structure. The aperture area of such a grating is $N\times\lambda\times M\times 1{,}41\times\frac{\lambda}{4}=0{,}35MN\lambda^2$.

Literature:

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