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ELECTRODYNAMIC CHARACTERISTICS OF THE NONRESONANT SYSTEM OF TRANSVERSE SLOTS IN THE WIDE WALL OF A RECTANGULAR WAVEGUIDE

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The method of induced magnetomotive forces is applied to the problem of electromagnetic wave radiation by a system of transverse slots located in the wide wall of finite thickness of a rectangular waveguide. The paper includes calculation of space-energy characteristics of linear multislot nonresonant antenna arrays of the leaky wave. Comparison of the numerical results, obtained by Galyorkin's method, with the experimental data is performed.

Among the present-day antenna systems (AS), waveguide-slot antenna arrays have found wide application [1–3]. Compared to other AS, they offer a number of advantages: absence of any protruding parts, simple excitation of a large number of radiators, and possibility of realization, in wide limits, of the required amplitude-phase distribution (APD) of fields (currents) in the AA opening.

Analysis of waveguide-slot AA can be performed either by approximate analytical methods [2, 3] or by numerical ones. Among the latter, most efficient, to our opinion, is Galyorkin's method [3–5]. In this case the equivalent magnetic currents $J_n(s_n)$ in every of N slots of the array can be determined, for example, as the expansion in trigonometric linearly independent basic functions [3, 4]:

$$J_n(s_n) = \sum_{p=1}^{P} J_{np} \sin \frac{p\pi(L_n + s_n)}{2L_n} \tag{1}$$

where s_n are local coordinates related to the slots of length $2L_n$, P is the total number of the basic functions, and J_{np} are unknown coefficients.

In the process of realization of the Galyorkin method, there arises the necessity in numerical treatment of an $N\times P$ system of linear algebraic equations (SLAE), and the computation time grows in proportion with $(N\times P)\times N$ [5]. Many authors limit themselves by approximation of the current in slots by a single function — the sine half-wave ($P = 1$ in formula (1)), when the Galyorkin method turns into the method of induced magnetomotive forces (mmf) [2, 3, 6, 7]. However, this approximation is valid only when the ratios between slot lengths and the working wavelength λ are close to 0.5 (so-called tuned slots), and becomes inconsistent at other values of $2L_n/\lambda$. In the case when $2L_n/\lambda \neq 0.5$, and distances between the neighboring slots are much less than the wavelength λ_n in the waveguide, the waveguide-slot AA represents one of variants of the leaky-wave antennas [6–9]. A typical feature of such structures is that the phase velocity of the electromagnetic wave propagating over the structure is larger than the light speed in the free space. Moreover, the amplitude and phase distribution of the currents in the slots can be varied independent of each other, especially in the event of a rather large number of radiators. Usually, at analysis of such antennas several assumptions are introduced [6]: the number of slots is infinite [6]; the thickness of the wall of the wave-guiding system, where the slots are cut, equals zero [6,

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