P3-21: Compensation of Wave E_{01} Reflection from a Dielectric Window on to the Horn Aperture

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Abstract *– the effective method of calculation is offered symmetric of E-waves of a round irregular wave guide. To satisfy calculations of factor of reflection of a horn with a dielectric window on the aperture. Conditions at which at the expense of a correct choice of parameters of a horn indemnification of the reflection brought by a dielectric window is realized are found.*

Keywords: horn, dielectric window, reflection factor, mathematical model operation

Introduction

Not always probably to pick up the thickness of a diaphragm corresponding to the minimum reflection at certain values of dielectric permeability ε. In this case the research problem of possibility of selection of such parametres of a horn (Fig.1) is actual, at which compensation of reflection from a diaphragm would be realized. Research of physical features of such compensation - is a problem of the given report. The dielectric diaphragm isolating vacuum space of powerful source the MICROWAVE is located on the horn aperture [4].

Statement of a problem and decision method

On Fig. 1. the geometry of a solved problem is presented. On an input of a horn in radius b_0

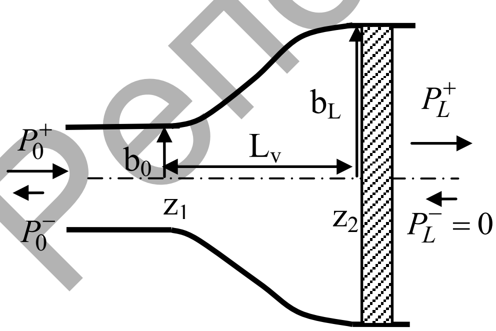

Figure 1. Horn with a dielectric window

moves symmetric E_{01} wave capacities P_0^+ ($V_0^+ = 1$). Radius aperture is b_L .

Forming a horn at $z_1 < z < z_2$ it was set in the form of a parabola having smooth interface to regular wave guides on an input and the aperture

$$b(z) = b_0 + (b_L - b_0) * P_5\left[(z - z_1)/(z_2 - z_1)\right],$$
$$P_5[x] = x^3\left(10 - 15x + 6x^2\right). \quad (1)$$

Parametres of horn $L_v = z_2 - z_1$ also b_L - stole up from a condition of the minimum reflection in the presence of a dielectric window in the thickness D_ε with dielectric permeability ε .

For performance of calculations be developed to was used modified for calculation of symmetric E-waves of a round irregular wave guide method the block-matrix prorace, earlier for calculation of H-waves [2, 3].

The idea of a method consists in reception by transformation of coordinates [1, 2] a scalar regional problem for symmetric E-waves on the regular cylinder of individual radi-us

$$\frac{\partial}{\partial z}\left(\frac{1}{\varepsilon\rho}\frac{\partial u}{\partial z}\right) - \frac{\partial}{\partial z}\left(\frac{b'}{\varepsilon b}\frac{\partial u}{\partial \rho}\right) - \frac{\partial}{\partial \rho}\left(\frac{b'}{\varepsilon b}\frac{\partial u}{\partial z}\right) + \frac{\partial}{\partial \rho}\left(\frac{1+(b'\rho)^2}{b^2\varepsilon\rho}\frac{\partial u}{\partial \rho}\right) = -\frac{W^2}{\rho}u$$

$$b' = db/dz, \quad u\big|_{\rho=0} = 0; \ \left.\frac{\partial u}{\partial \rho} - \frac{bb'}{1+b'^2}\frac{\partial u}{\partial z}\right|_{\rho=1} = 0, \quad (2)$$

added with radiation conditions on the ends of a piece of a considered wave guide [2]. Thanks to the area regularity, the given problem dares an effective direct a method block matrix proraces [1]. Component $B_\varphi(r,z)$ a symmetric E-wave it is expressed through function $u(z,\rho)$, $\rho = r/b(z)$ as follows

$$B_{\varphi}(r,z)=u(\rho,z)/(\rho b(z))=$$
$$=\frac{1}{e_{0i}}\sum_i V_i(z)J_1\left(\nu_{0i}\frac{r}{b(z)}\right), \qquad (3)$$

V_i – amplitudes of partials E_{0i} waves. Unlike a problem for H waves [2] here the boundary condition (2) has a non-standard appearance. The reflection factor on capacity E_{01} – waves in a horn with a dielectric window paid off under formula

$$K=1-P_L^{+}/P_0^{+}, \qquad (4)$$

where P_0^{+}, P_L^{+} - submitted on an input and passing capacities. Below geometrical sizes are resulted in terms of $\lambda/2\pi$.

Results of calculations

For a typical monotonous horn of the E-wave without dielectric windows with entrance radius b_0=3 it has been established that at $b_L=8\div10$ and $L_V\geq12\div14$ accordingly, the factor of reflection K does not surpass 0.007. At a premise in having opened such horn of a "reflecting" diaphragm factor of reflection of a horn corresponds to factor of reflection from such diaphragm and can reach 0.2-0.4 for ε=2-5. Calculations have shown what to compensate reflection from a dielectric window it is possible at the expense of a corresponding choice of parametres b_L, L_v, providing a minimum of factor of reflection K.

On Fig. 2. distribution of amplitudes in a horn with "a reflecting" diaphragm before optimization is presented. In results optimization of parameters the reflection factor appears not big than at a horn without a diaphragm. Apparently from fig. 2b in a horn to such parameters there is a re-reflection of waves between a diaphragm and irregular site a wave guide.

Conclusion

As a result of computing experiment it is shown (Fig. 2.), that a corresponding choice of parametres system «a horn-dielectric the window» represents the half-wave transformer and practically full indemnification of reflection is reached, as and for H_{01}-wave [4].

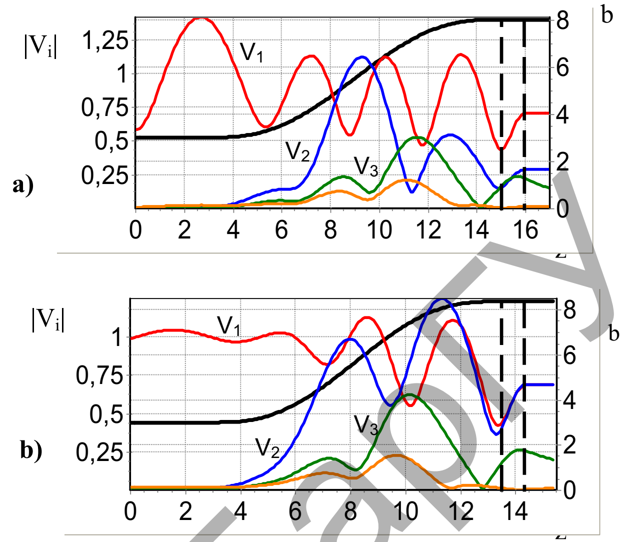

Figure 2. Horn with a "reflecting" window:
b_0=3, ε=2.5, Dε=1,
a) befor optimization b_L=8, L_v=12, K=0,17,
b) after optimization b_L=8.37, L_v=10,37, K=0,003

References

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