P3.25: Research of Dependence of a Reflectivity by of Symmetrical H_{0i}-Waves on Geometrical Parameters of Filters in a Hollow Irregular Waveguide

Oksana I. Naranovich, Anatoliy K. Sinitsyn
Belarusian State University of Informatics and Radioelectronics
6, P.Brovki str., Minsk-220013 Belarus e-mail: sinitsyn@cosmostv.by

Abstract: *In this report tasks of synthesis of a longitudinal structure of a wall of a waveguide and characteristic Bragg filters as a groove and periodic corrugation for a symmetric H_{01}-wave of a round waveguide are investigated.*

Keywords: hollow irregular waveguide, Bragg the filter, mathematical model operation

Introduction

Reflecting Bragg filters of type have found useful application in powerful electro vacuum generators at realization open from two sides for passage of an electronic stream of resonators. To provide required characteristics of the specified devices it is possible due to synthesis of a longitudinal structure of a wall of a wave guide on a basis optimization procedures and the decision of a regional task for Maxwell's equations.

For realization this tasks the procedure of the decision successfully combining a method of transformation of coordinates , the subsequent data to system the ODE is offered on the basis of a method of straight lines and a method of the block matrix run effectively realizing direct method Gauss with a choice of the main element for received SLAU at use of methods of storage and work with rarefied matrixes. The new effective numerical method of the solution of problems for the irregular wave guides is in details stated in [1, 2].

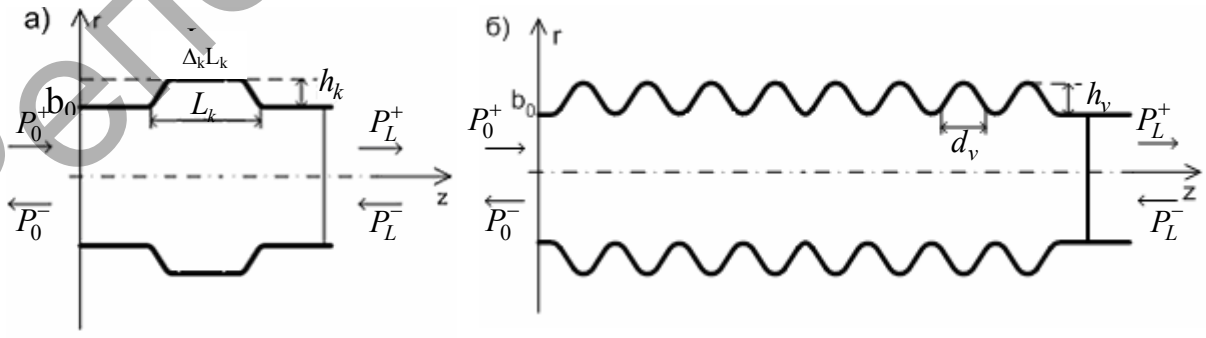
In the this work with the help of this method geometrical parameters of filters as a resonant flute of the certain configuration and as periodic of corrugation, providing practically full reflection H_{01} - waves are found at radiuses of a wave guide, opaque for H_{02} - waves.

The similar problem for E_{0m} -waves is explored in [3].

Main Part

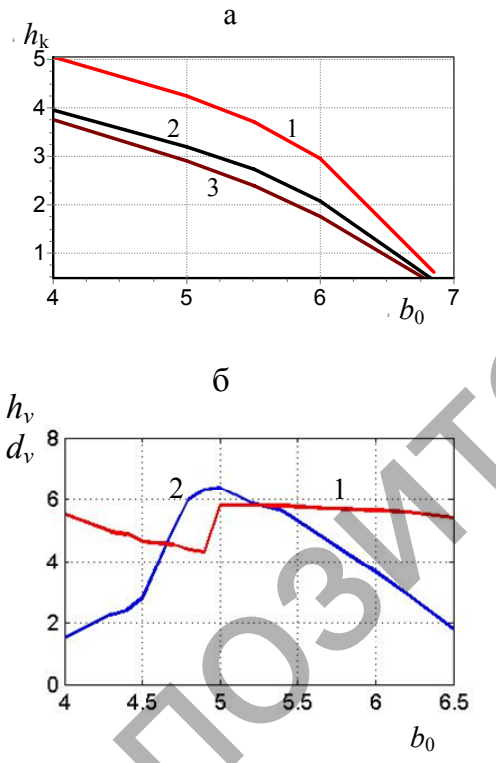
Parameters h_k, L_k, h_v, d_v of the filters submitted on Fig. 1. are selected from a condition of a maximum of factor of reflection $K = 1 - P_L^+ / P_0^+$. For values of radius of a waveguide b_0 within the limits of $3.83 < b_0 < 7.016$ it was made optimum search of parameters at which the maximal reflection of the H_{01}-wave is provided. Calculations have shown, that for any value b_0 in a considered range there are parameters of filters at which is provided practically full $(K > 0.995)$ reflection.

Features of filters as a resonant groove. At fixed Δ_k, L_k with increase b_0 depth h_k a resonant flute monotonously decreases (Fig. 2a). At reduction of width of flute L_k its height grows. With increase in a steepness of walls of a flute $(\Delta_k \uparrow 1)$ at the fixed width its height decreases up to some limiting size. At $(\Delta_k \to 0)$ height of a reflecting resonant flute it becomes unacceptable big. So, for $b_0 = 5.5$, $L_k = 5.5$ at $\Delta_k \cong 1$, $h_k = 2.5$, and at $\Delta_k = 0$, $h_k = 7.6$. The height of resonant flute provides opening raised H_{02} - fashions with the amplitude comparable to amplitude of the basic wave, and crest of a wave gets approximately on the center of a flute.



а) The filter as a groove, б) the filter as a piece sine wave corrugation
Fig. 1. Geometry of considered filters

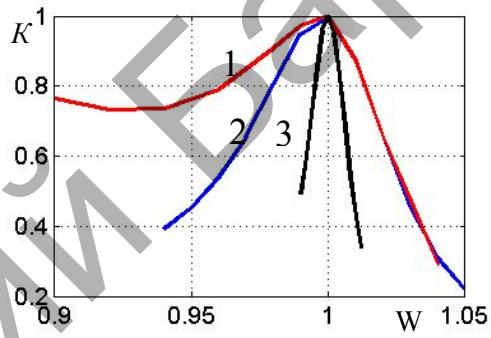
Features of filters as n_v *- periodic sine wave corrugation.* At the found optimum period d_v with increase in depth h_v the factor of reflection K monotonously grows. Dependence from b_0 the optimum period d_v and value of depth corrugation h_v is investigated at $K = 0.995$. Non-monotonic dependence of depth corrugation from b_0 is received, and also there is a jump of dependence $d_v(b_0)$ at $b_0 \approx 5$, Fig. 2b. At distance from border $b_0 = 3.83$ strips of a transparency the period monotonously decreases, and required depth corrugation grows up to the values surpassing radius of a wave guide. Since $b_0 > 4.5$, the height corrugation is inside it the H_{02}-wave.



а – filter as a resonant groove, Δ_k=0.7;
curves 1 - L_k=4.5, 2 - L_k=5.5, 3 - L_k=6.5;
б – filter as 8 - periodic sine wave corrugation;
curves 1 – d_v, 2 – h_v.

Fig. 2. Dependence of parameters of blocking filters on radius of a wave guide

If at such height to proceed to size of the period corresponding to a resonance of one sine wave flute already the first flute corrugation provides required easing a wave. With increase b_0 gradually appear all are involved in easing a wave corrugation the filter. *Band-pass performances of filters* are illustrated with Fig. 3. As one would expect, filters as one resonant flute have very narrow strip of reflection of 1-4% at level $K > 0.8$. The strip is narrowed at reduction of height of a flute and increase b_0. Apparently from a course of curves, at approach b_0 to boundary of a band of a transparence the reflectivity K with diminution of frequency from W=1 in the beginning is reduced, then is incremented up to unity at reaching a point of a cutoff. The strip of reflection at level $K > 0.8$ periodically corrugation filters changes within the limits of 5-12 %.



filter as a resonant groove Δκ=0.7
1 - b_0=4.5, L_{k0}=5, h_{k0}=3.95;
2 - b_0=5.5, L_{k0}=5, h_{k0}=3.05;
3 - b_0=6.5, L_{k0}=5, h_{k0}=1.41.

Fig. 3. Dependence of a reflectivity *K* from frequency

Conclusion

The analysis of variants of filters of the considered configuration shows, that for any radius of a wave guide b_0 at which distribution only H_{01} - waves is provided, it is possible to pick up values of the parameters providing the required level of reflection in a strip up to 10 %.

References

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