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A RING-SHAPED BRIDGE IN PARTIALLY FILLED RECTANGULAR WAVEGUIDES

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Conditions for matching the joints in a ring bridge are defined. The main part of the bridge is a partially filled rectangular waveguide consisting of four *E*-couplers. Numerical results are obtained for various sizes of the dielectric plate (not contacting with waveguide's walls) and of waveguide walls — both in the ring and side segments.

The microwave channels of radar and radio-navigation stations of flying vehicles, ground-based air traffic control service, seagoing and river vessels etc., are complex waveguide joints with bridge devices such as ring bridges. Usually this device represents a waveguide ring curved in the *E*-plane, and four connected-in-series waveguide segments with a pitch of $(1 + 2k)\Lambda/4$, where Λ is wavelength in the waveguide, and $k = 0, 1, 2, 3,\ldots$. If the waveguides' segments (the bridge branches) are terminated by matched loads, the power applied to one of the arms will be divided in two while the other arm remains inactivated. The better matching of the ring-shaped joints the more accurately the bridge properties are observed. The main disadvantages of the waveguide ring bridges are their narrow band of working frequencies and large overall dimensions. The use of rectangular waveguides partially filled with dielectric in microwave channels makes it possible to expand the pass-band and diminish considerably the mass and dimensions of microwave channels of radar and radio-navigation stations, which is especially important in airborne applications.

The purpose of this work is to determine the conditions of matching of the joints in a ring bridge using a partially filled rectangular waveguide (PFRW).

Consider a ring bridge (Fig. 1) consisting of four *E*-couplers in PFRW. The PFRW couplers have been investigated in [1] while the uniformly curved PFWR — in [2]. The coupling openings of the ring waveguide coincide with the cross-section of the side waveguides. Only the fundamental wave, type quasi-H_{10}, is propagating over all the waveguides. The conductances of the plane-transverse joints b_1, b_2, b_3, b_4 take the local fields arising at the joints into account. The distances between the side waveguides are such that the interaction, for higher modes, between the plane-transverse joints is absent. The reduced conductance of the matched side waveguide, with regard for the joint reactance, can be written as $y_c = 1 + jb_c$, where $b_c = b_1 = b_2 = b_3 = b_4$. The conductance is normalized with respect to the characteristic conductance of the fundamental wave, type quasi-H_{10}. With regard for tracing the ring waveguide by the fundamental wave in two directions, the normalized conductance of the ring waveguide takes the form

$$y_{\mathrm{r}} = 2(1 + \mathrm{j}b_{\mathrm{c}})/n_0^2, \quad n_0 = \int_S \overline{\mathrm{E}}\,\overline{\varepsilon}_0 \mathrm{d}S, \quad b_{\mathrm{c}} = \sum_{0,\nu} n_{0,\nu}^2 Y_{0,\nu}, \quad n_\nu = \int_S \overline{\mathrm{E}}\,\overline{\varepsilon}_\nu \mathrm{d}S,$$

where ε_0, ε_ν are transverse electric proper vector functions of PFRW for the fundamental and higher modes [3]; $Y_{0,\nu}$ are characteristic conductances of PFRW waves; and S is the area of the coupling aperture of the ring-shaped and side waveguides. For the function E, approximating the distribution of tangential electric field on the coupling aperture, we take the proper vector function of the uniformly curved in the E-plane PFRW for the fundamental wave [2].

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