Field in a Complex Cylindrical/Coaxial Cavity Subject to Time-Harmonic and Transient Excitation

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The field in a complex cylindrical cavity is investigated. We present a coupled-integral-equation method for calculating the field in a cavity constructed from multiple cascaded and overlapping coaxial and circular-cylindrical regions or sections. The regions may have different axial and radial dimensions and may be filled with material having different electrical and magnetic properties. The cavity walls are perfect electric conductors. The first and last sections are coaxial cavities whose dimensions are such that higher order modes are cutoff, leaving only the TEM mode to propagate. The source is taken to be a TEM mode in the sending-end (first section) coaxial guide. The field in a section is related to the field in apertures in planar conducting surfaces, which bound the section. One interface may contain more than one aperture and, hence, may be part of a boundary of more than two regions. A set of integral equations in matrix form is developed and solved by numerical methods. In order to illustrate the solution method and demonstrate its accuracy, a cavity is constructed and analyzed, and the results are compared with data obtained through measurement. Both frequency domain and time domain results are compared. The accuracy of the method is also verified by comparison of measurements and calculations of the current and charge on the center conductor. Special probes are used for measuring signals proportional to the current and charge at various points along the surface of the center conductor. The probes protrude through a slot in the inner tube and may be displaced axially along the center conductor. Results obtained from calculations compare very favorably with the measured charge and current on the inner cylindrical conductor.