all combinations of ratio of line radii, ratio of dielectric constants, and step ratio. However, approximate values may be obtained by recognizing as in E and F above that the major distortion of field occurs in the wider region; this region then has the most important effect upon the discontinuity admittance, and for a first approximation, the discontinuity capacitance for air dielectric may be multiplied by dielectric constant in the line of wider section. Thus in Fig. 6(a), the discontinuity

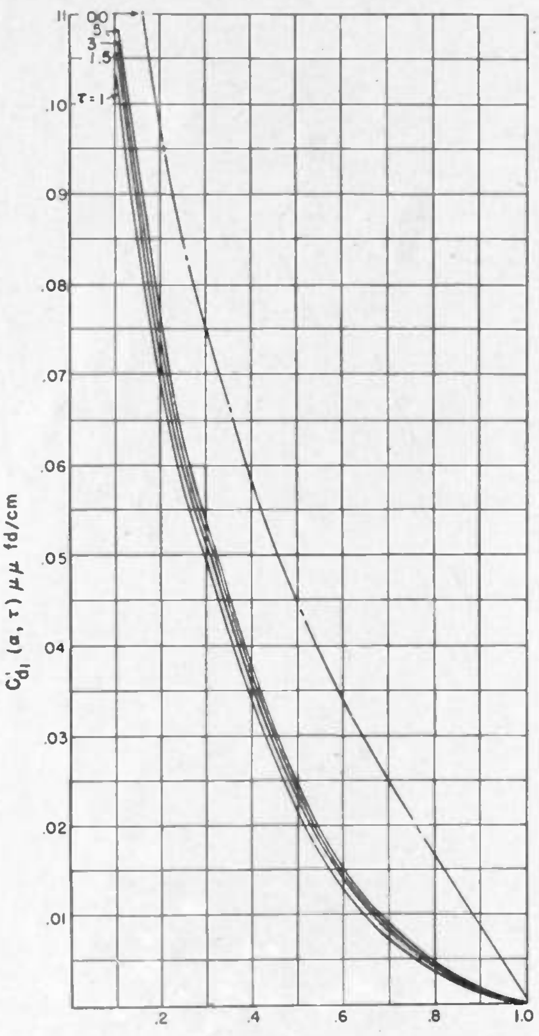

Fig. 8—Curve of $C_{d_1}'(\alpha, \tau)$. When multiplied by outer circumference, gives directly the discontinuity capacitance for Fig. 7(a) with $\alpha = a/b$, $\tau = r_3/r_1$.

capacitance C_d is not greatly changed from that for a completely air-filled line even though the dielectric d is present; in Fig. 6(b), discontinuity capacitances for an air-filled line should be multiplied by approximately ϵ'.

This approximation and the other approximations mentioned in E and F based on the relative straightness of field lines in the smaller line are poorest for small discontinuities—that is, for discontinuities where the percentage change in section is small. However, since discontinuity capacitances for such cases are very small anyway, it is usually not necessary to be too concerned about their accuracy.

H. Transmission Lines of General Cross-Sectional Shape

Hahn's unpublished work, referred to in reference 1, in which he obtained the equivalent circuits for transmission-line discontinuities, was for coaxial lines, as in this paper. The previous paper[1] derived the equivalent circuits for the simpler parallel-plane transmission-line problems. It would of course be possible to set up the problem more generally, starting with a principal transverse electromagnetic wave and local waves expressed in terms of general orthogonal function distributions over the cross section. (The sinusoids of the parallel-plane transmission-line and the Bessel functions of the coaxial

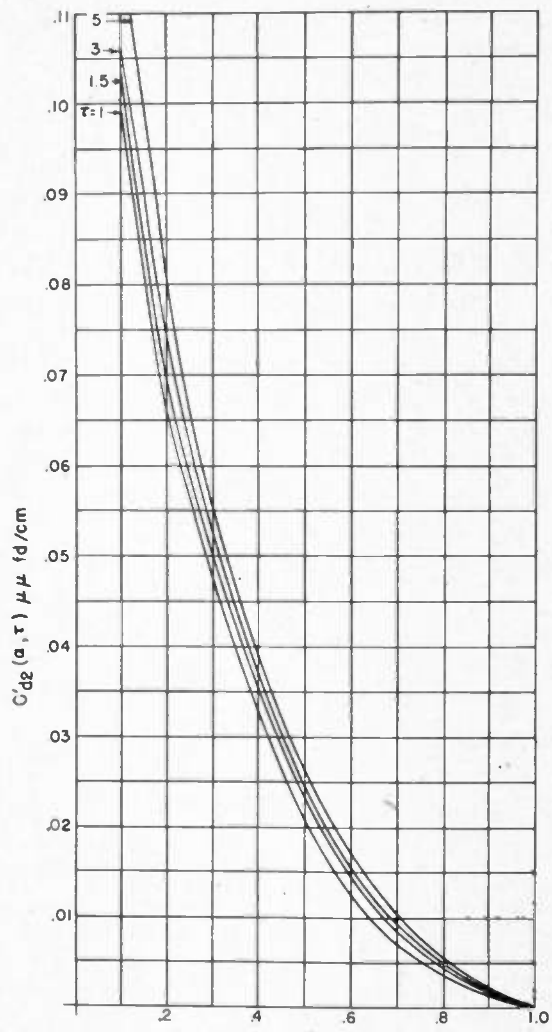

Fig. 9—Curve of $C_{d_2}'(\alpha, \tau)$. When multiplied by inner circumference, gives directly the discontinuity capacitance for Fig. 7(b) with $\alpha = a/b$, $\tau = r_3/r_1$.

line are two examples of functions having the required orthogonal properties.) The equivalent circuit would then be found to have the same form as that in Fig. 1(c) for all such general cases of sudden discontinuities, and expressions for the lumped discontinuity admittances could be obtained in terms of the general functions. If the local waves were all transverse magnetic or E waves, the lumped admittance would behave as a capacitance at low frequency, as inductance if they were all