current, λ the wave-length, ρ the distance from the axis and z the distance along the axis. The open end is in the plane $z=0$.

The field can be obtained from a vector potential whose components are

$$A_\rho = A_\varphi = 0, \quad A_z = \frac{iI}{2\pi}\log\frac{\rho}{\rho_0}\sin\beta z. \tag{2}$$

This can be verified by substitution in

$$H_\varphi = -\frac{\partial A_z}{\partial \rho}, \quad E_\rho = \frac{1}{i\omega\epsilon}\frac{\partial^2 A_z}{\partial\rho\partial z}. \tag{3}$$

The values of the above wave function and its normal derivative over the aperture are

$$A_z = 0, \quad \frac{\partial A_z}{\partial n} = \frac{i\beta}{2\pi} I \log\frac{\rho}{\rho_0}. \tag{4}$$

Using the Kirchhoff formula in the customary manner (i.e., by applying it to the aperture) we find that at great distances from the aperture the approximate value of A_z is

$$A_z = -\frac{iI}{4\lambda}\left[\left(b^2\log\frac{b}{\rho_0} - a^2\log\frac{a}{\rho_0}\right) - \tfrac{1}{2}(b^2-a^2)\right]\frac{e^{-i\beta r}}{r}. \tag{5}$$

From this we calculate the field and then the radiated power; thus we obtain

$$W = \frac{40\pi^4}{\lambda^4}\left[\left(b^2\log\frac{b}{\rho_0} - a^2\log\frac{a}{\rho_0}\right) - \tfrac{1}{2}(b^2-a^2)\right]^2 I^2. \tag{6}$$

By choosing ρ_0 properly we can make the radiated power W equal to anything from zero to infinity. The approximate value for W found with the aid of the Equivalence Principle corresponds to ρ_0 satisfying

$$b^2\log\frac{b}{\rho_0} - a^2\log\frac{a}{\rho_0} = 0. \tag{7}$$

Note: On Diffraction and Radiation of Electromagnetic Waves

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Dr. Schelkunoff has kindly shown us the manuscript of the preceding paper which is closely allied to ours.[13] Since our formulation of the problem differs somewhat from that of Dr. Schelkunoff in "Some Equivalence Theorems of Electromagnetics and Their Application to Radiation Problems,"[14] and in the preceding paper, it appears worth while to point out that the results obtained by the Equivalence Principle are identical with ours. If the field of the equivalent surface currents is calculated from the vector potential or the Hertz vector, the contour charges need not be introduced explicitly. The contour charges simply ensure the self-consistency of the assumed field on the surface.

[13] J. A. Stratton and L. J. Chu, "Diffraction Theory of Electromagnetic Waves," Phys. Rev. **56**, 99–107 (1939).
[14] S. A. Schelkunoff, Bell Sys. Tech. J. **15**, 92–112 (1936).