$$E_x = A\sqrt{z}J_p(kz) + B\sqrt{z}J_{-p}(kz)$$

where

$$p = [(z_c/\lambda\!\!\!^-)^2 + 1/4]^{1/2} \geq 1/2.$$

Reference to the asymptotic expression[6]

$$\sqrt{z}J_{-p}(kz) \approx z^{1/2-p},$$

which holds for $z \to 0$, shows that this part of the solution must be rejected to obtain a finite solution at the origin, corresponding to the case in which the plasma is backed by a metal wall as in Fig. 2(b).[7] The solution for the plasma with the inverse quadratic density distribution is then

$$E_x = \sqrt{z}J_p(kz)$$

where $p \approx z_c/\lambda\!\!\!^-$ (assuming $z_c > \lambda\!\!\!^-$).

Now, comparing (6) and (10) (with $\theta = 0$) we see that the waveguide and plasma shown in Fig. 2 exhibit analogous behavior with respect to a TE wave propagating toward the origin. In particular, the wave undergoes "reflection" in the neighborhood of the critical density z_c or the critical cross section r_c. Similarly, an evanescent wave arises at the critical point and damps out toward the origin. Thus, analog experiments carried out with appropriate tapered-waveguide configurations appear to be useful for simulating inhomogeneous plasma media in the vicinity of critical densities. Such experiments would require slowly-varying taper structures in order to minimize effects due to generation of spurious modes at junctions with other microwave elements.

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The Diffraction Loss Curve for Nonconfocal Spherical Mirrors

The diffraction loss curve vs Fresnel number for confocal spherical mirrors was shown by Fox and Li[1] and by Goubau and Schwering.[2] Boyd and Gordon[3] suggested a possibility of applying the above theory to a nonconfocal mirror system, by assuming the diffraction loss to be equal to that of an equivalent confocal system having the same

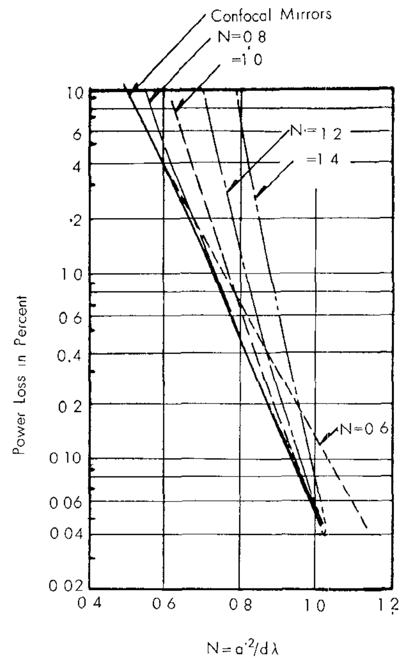

Fig. 1—Diffraction loss for a nonconfocal system of spherical mirrors.

spot size. They proposed to express the diffraction loss in term of the parameter

$$\frac{a'^2}{d\lambda}\left[2\frac{d}{b'} - \left(\frac{d}{b'}\right)^2\right]^{1/2}$$

in place of the conventional Fresnel number N.

The approximation by Boyd and Gordon has been found nearly valid by Fox and Li[4] for the range of $0.2b' < d < 1.8b'$ in the calculation of infinite strip curved mirror interferometers for $N = 0.5$.

Using the Boyd and Gordon approximation, the diffraction loss for a nonconfocal system may be expressed as a function of the above parameter, which can be modified to the form

$$N\left[2\left(\frac{b'}{d}\right) - 1\right]^{1/2}$$

where

b' = radius of curvature of mirrors
d = spacing between mirrors
N = Fresnel number
$= a'^2/b'\lambda$
a' = radius of mirrors.

The above new parameter corresponds to the Fresnel number N for a confocal system, and the diffraction loss for a nonconfocal system can be easily obtained using the loss curve for a confocal system by replacing N to the form modified by the factor

$$\left[2\left(\frac{b'}{d}\right) - 1\right]^{1/2}.$$

On the other hand, it is sometimes required to calculate the variation of the diffraction loss for a nonconfocal system with the spacing between mirrors for constant mirror curvature and wavelength. In such a case, it seems more convenient to use the new parameter N' as defined by the formula

$$N' = \frac{a'^2}{d\lambda}.$$

With this parameter, the diffraction loss for a nonconfocal system can be illustrated for various values of N as shown in Fig. 1. The solid line in the figure denotes the loss curve for a confocal system for comparison. These curves seem to have sufficient accuracy in the range of $0.2b' < d < 1.8b'$.

When the diffraction loss for a nonconfocal system was measured for a variable mirror spacing, the measured value should be compared with the curve shown in Fig. 1, not with the loss curve for a confocal system. It is considered that the results of the measurement made by Beyer and Scheibe[5] may be compared more adequately with the curve in Fig. 1 for a given value of N.

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Semiconductor Switching and Limiting Using 3-db Short-Slot (Hybrid) Couplers

The silver-bonded germanium varactor diode has been successfully used as a switch and a limiter of microwave power when operated in a series mode between 9.0 and 9.6 Gc.[1] This report gives details of shunt mode switching and limiting using these same type diodes in conjunction with 3-db short-slot (hybrid) couplers. The technique of using 3-db short-slot (hybrid) couplers, but with other type diodes (*e.g.*, 1N263, MA-450, PIN's), has been reported by other investigators.[2–4]

Fig. 1 is a diagrammatic illustration of the short-slot (hybrid) coupler. If arms B and C are terminated in perfectly matched

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