Correspondence

Planar Transmission Lines—II

I would like to call your attention to a certain mistake in the above paper.[1] Park's transmission line, consisting of two parallel strips between two wide plates [Fig. 1(a)], has to be changed to the line geometry indicated in Fig. 1(b) in order to maintain the results of the mentioned paper.

The mistake originates from a false interpretation of

$$jz' = \sqrt{k_p}\ \mathrm{sn}\ (jKZ/H), \quad (6)$$

in particular of the elliptic function sn x.

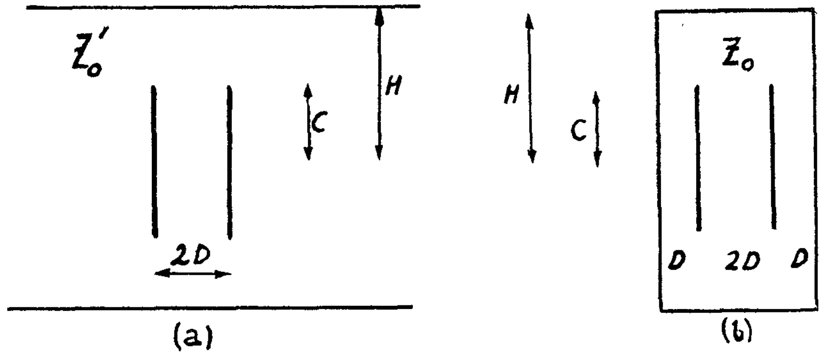

Fig. 1—(a) Open and (b) enclosed parallel plate lines.

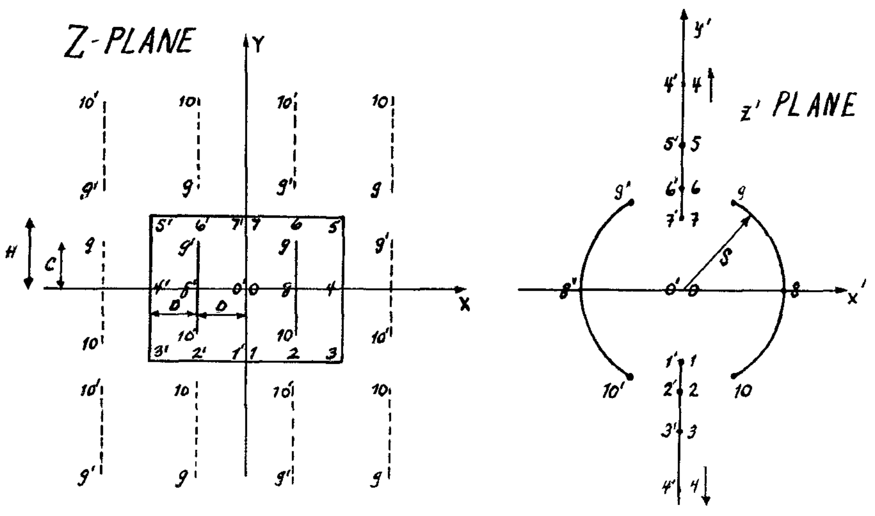

Fig. 2—Mapping of Z plane into z' plane by means of (6).

The correct mapping is shown in Fig. 2. One should note that sn x is a double periodic function. That is the reason why the two strips 9-10 and 9'-10' are actually within the rectangular box 3'-3-5-5' in contrast to the geometry given in the mentioned paper. The box is transformed into the imaginary axis of the z' plane which is a potential line of the configuration and therefore does not impair the field between the two circle electrodes 9-8-10 and 9'-8'-10'.

In order to check the validity of the statements made one can easily calculate the characteristic impedances of the open and enclosed parallel plate lines (Fig. 1) for the special case $H \rightarrow \infty$ and $C \gg D$. The impedance of the open line is found to be $Z_0' = 120\pi D/C$, and from the exact formulas of Park one has $Z_0 = 60\pi D/C$ which is half the value of Z_0' and therefore corresponds to the configuration of Fig. 1(b).

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[1] D. Park, Trans. IRE, vol. MTT-3, pp. 7–11; October, 1955.

Rebuttal

I should ike to thank Dr. Giger for pointing out this error—it was due to an uncritical use of somebody else's formula—and to express my regret that it should have occurred. It might be added that the problem which I have solved by inadvertence is one which arises naturally out of my first paper,[2] and (if there are no further errors) may possibly be of greater practical use than that whose solution Dr. Giger has criticized.

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[2] David Park, "Planar transmission lines," Trans. IRE, vol. MTT-3, pp. 8–12; April, 1955.

Determination of the Parameters of Cavities Terminating Transmission Lines

The method of measuring cavity parameters outlined in the above paper[1] has been used successfully for some time by our laboratory for measuring parameters of cavities at X band having Q's as high as 150,000. For improved accuracy in these measurements, an additional refinement has been made in the method which makes all measurements independent of the law of the crystal detectors used.

The method consists simply of inserting immediately after the signal generator, in Libowitz's circuits, a precision calibrated attenuator. This attenuator is used to refer all measurements to a fixed power level in the crystal. For example, in measuring loaded Q the 3 db point on the observed cavity absorption dip is determined by changing the attenuator 3 db. VSWR measurements of coupling parameters are taken in db from the attenuator and converted to other desired parameters by the scales on a Smith Chart. Such measurements are simplified further by use of a dc coupled oscilloscope.

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[1] R. A. Libowitz, Trans. IRE, vol. MTT-4, pp. 51–53; January, 1956.

A Low VSWR Matching Technique

A variation on the method described by Feller and Weidner[1] for obtaining low standing wave ratios over a frequency band has

[1] R. G. Fellers and R. T. Weidner, "Broad-band waveguide admittance matching by use of irises," Proc IRE, vol. 35, pp. 1080–1085, October, 1947.

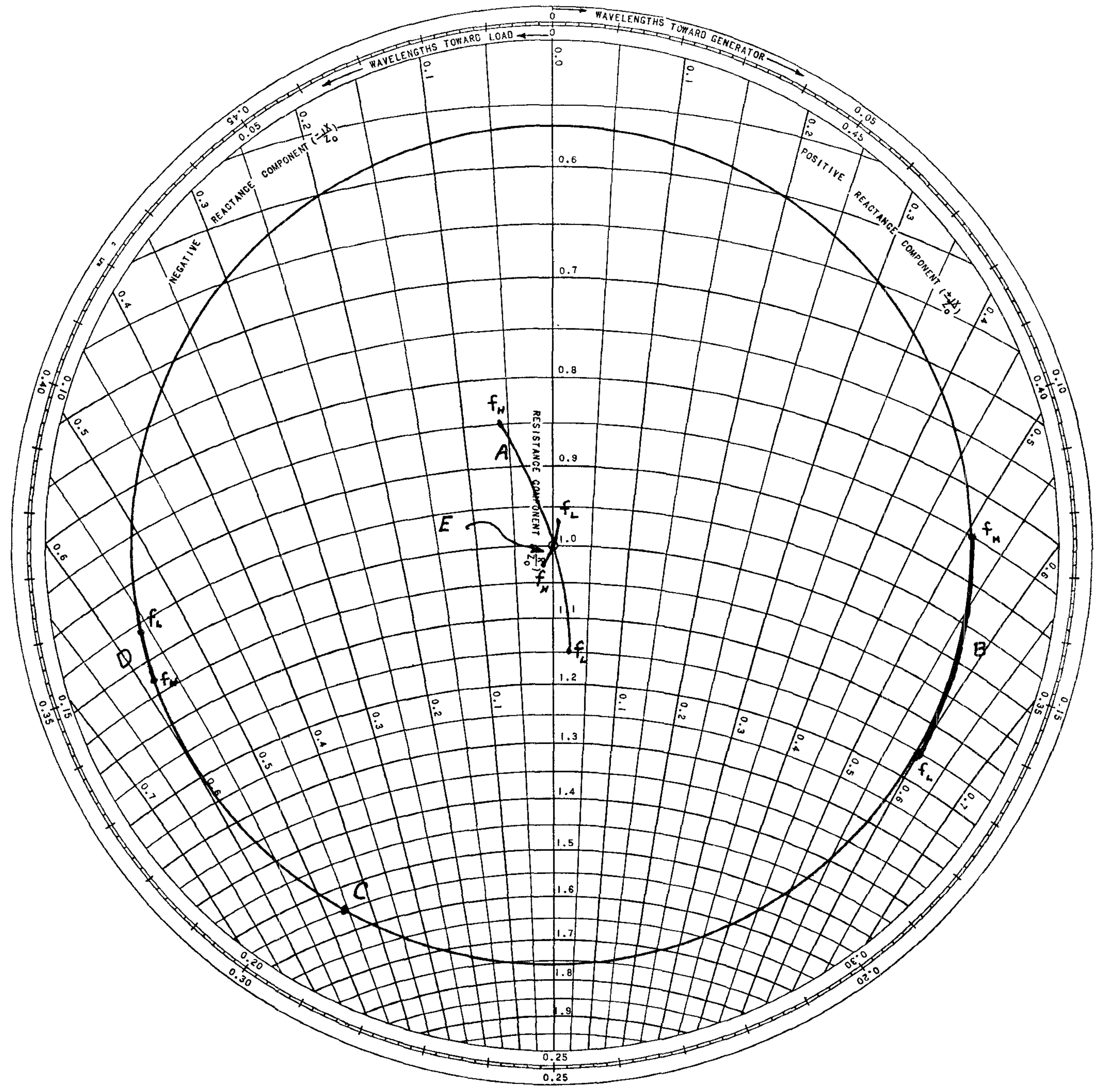

Fig. 1

proven to be very useful in the design of low vswr microwave components. If curve A in Fig. 1 represents the input admittance of the device to be matched, the method described by Feller proceeds as follows:

1) Insert a value of susceptance which causes the curve to lie along a constant vswr circle (curve B).
2) Move toward the generator until the frequency sensitivity of the line length causes the curve to reduce to a point (point C).
3) Move to the nearest intersection with the $g=1$ circle (curve D).
4) Insert a value of susceptance which transforms the admittance plot to the center of the chart; *i.e.*, a matched condition (curve E).

Although this method insures that the admittance plot is on a constant vswr circle, it does not guarantee that the plot will lie along a constant phase line *at the point where the final susceptance is to be inserted*. In order to satisfy both conditions, a method will be described which although involving some trial and error leads to the desired result in about two attempts. Given the admittance plot A in Fig. 2, the method is as follows:

1) Insert a value of susceptance which produces a phase spread θ equal to the phase sensitivity of a $3/4\lambda$ length of line (curve B). That is,

$$\theta = \frac{3/4\lambda_{g0}}{\lambda_{gH}} - \frac{3/4\lambda_{g0}}{\lambda_{gL}} = 3/4\left(\frac{\lambda_{g0}}{\lambda_{gH}} - \frac{\lambda_{g0}}{\lambda_{gL}}\right) \quad (1)$$

where λ_{gL}, λ_{g0}, and λ_{gH} are the guide wavelengths at the low, center and high ends of of the frequency band respectively.

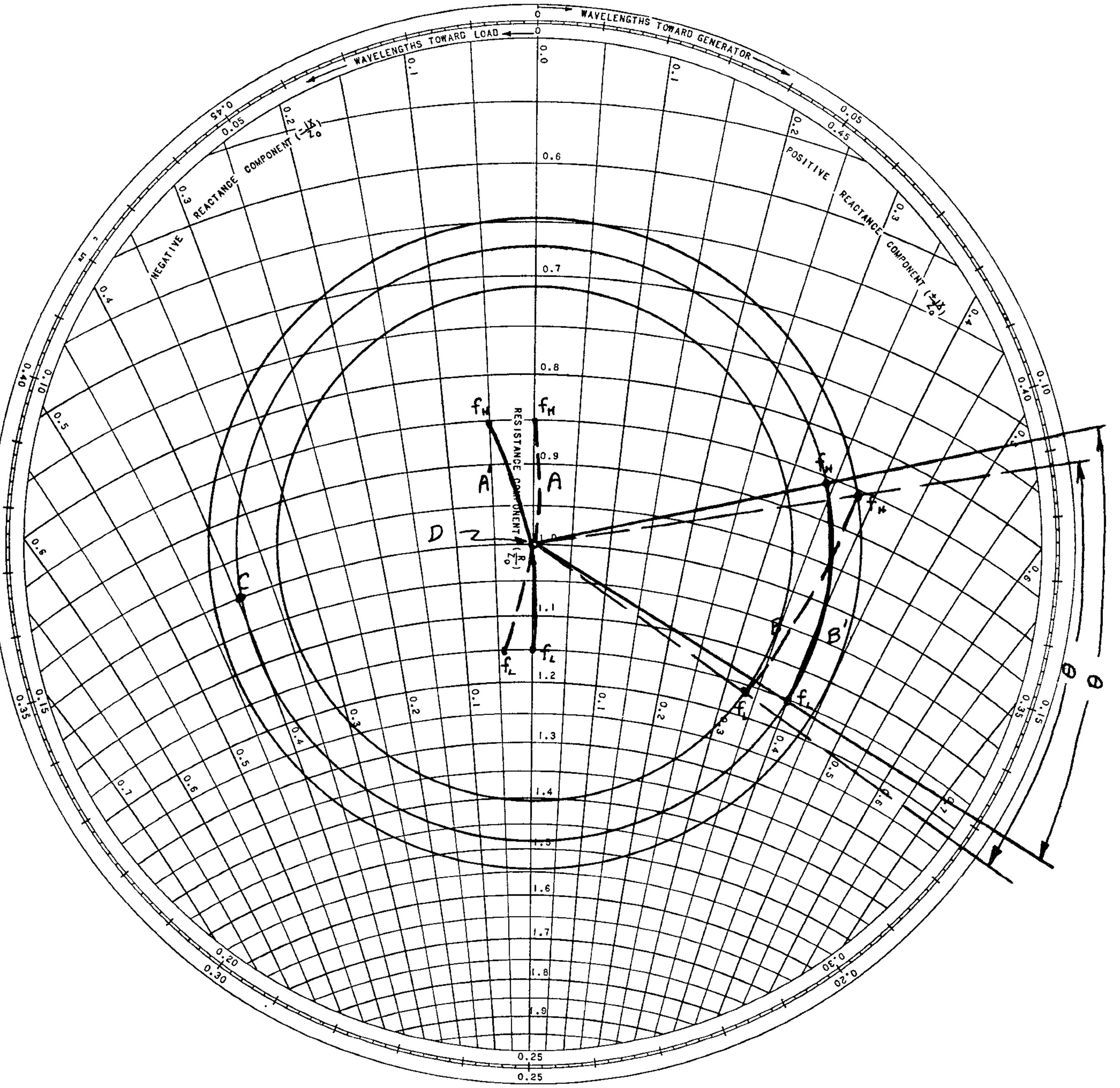

Fig. 2

2) Since curve B is not a constant vswr circle, change the original curve A in order to have the admittance plot lie on a constant vswr circle and yet maintain a phase spread given by (1). This can be done by inserting the first susceptance at a point along the transmission line corresponding to the admittance curve A' instead of a point corresponding to the curve A. Introduction of the susceptance at this point now yields the admittance curve B' which is on a constant vswr circle and has a phase sensitivity equal to that of a $3/4\lambda$ length of line.

3) Now move approximately $3/4\lambda$ toward the generator which reduces the admittance plot to the point C.[2]

4) Insert a second susceptance, identical to the first, which transforms the admittance plot to the center of the Smith Chart; *i.e.*, a matched condition (point D).

In the above discussion no mention has been made of the frequency sensitivity of the irises. However, it can easily be shown by use of the Smith Chart that since the two susceptances are equal in both amplitude and sign, their frequency sensitivities will cancel each other. Therefore in using the above method, the frequency sensitivity of the susceptances can be neglected.

This method has been used in matching components with admittance plots not as well behaved as those shown in Figs. 1 and 2. Standing wave ratios of less than 1.03 across a 6 per cent frequency band have been obtained.

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[2] A $3/4\lambda$ line length is chosen in preference to a $\lambda/4$ line length in order to avoid the possibility of higher order mode interaction between the susceptances In addition, the size of the irises required is reduced by this choice.