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Improved Circularly Polarized Planar-Array Antenna

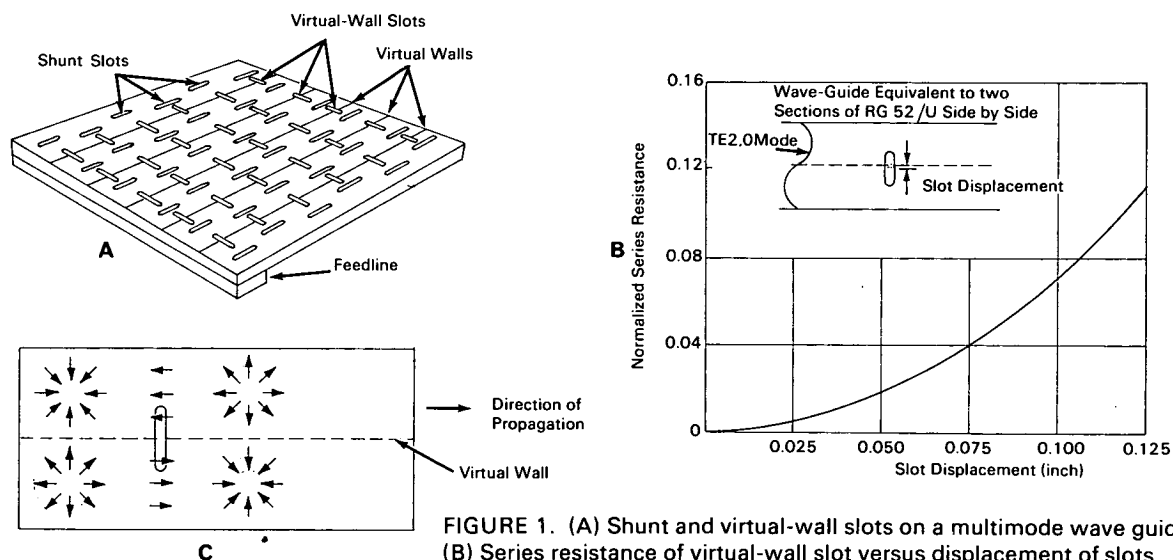


FIGURE 1. (A) Shunt and virtual-wall slots on a multimode wave guide. (B) Series resistance of virtual-wall slot versus displacement of slots center from wall. (C) Virtual-wall-slot excitation.

Formerly, the best-known method of generation of a circularly polarized beam, from the aperture of an antenna of the planar-array type, has been with the antenna used in Surveyor; it is a high-gain antenna having a planar configuration and generating a circularly polarized beam by use of a combination of crossed slots and pairs of complex slots. For avoidance of generation of large end-fire beams and for high efficiency of the aperture, a slow-wave structure had to be used on the bottom wall of the wave guide. The structure took the shape of a corrugated surface.

This new invention uses slots sitting astride the virtual wall in a multimode wave guide (fig. 1A); they do not radiate when perfectly centered on the

virtual wall, and the amplitude of excitation is conveniently controlled by the distance of displacement of the slots from the wall (fig. 1B). Furthermore, in-phase excitation (fig. 1C) of successive slots; with $\lambda_g/2$ interelement spacing, may be effected by alternation of the direction in which the slots are displaced from the wall. The virtual-wall slots can be used for generation of one component of a circularly polarized beam, with a high degree of efficiency, without use of a slow-wave structure. Shunt slots in an ordinary configuration are used for generation of the other component.

Absence of a slow-wave structure makes the antenna simpler and cheaper to design and build than

(continued overleaf)

the earlier type. Another advantage lies in the fact that the slots are resonant and can be designed as low-Q elements for broadband operation; Surveyor's planar array used nonresonant slots that are quite sensitive to frequency.

This slot configuration is now called Slot Configuration No. 1; three more configurations have since been discovered (1). A "choked" virtual-wall slot (1) now enables design of circularly polarized planar arrays having tapered amplitude distributions in both planes; a nearly solid wall is used along the virtual-wall line, with chokes below the virtual-wall slots. Thus unequal amounts of power may be carried in adjacent wave guides—a condition that was impossible in the older multimode line.

Although designed for spacecraft this innovation is primarily a communications antenna that could be used for earthbound links requiring compact planar-array antennas having narrow bandwidths; it generates circular polarization in a configuration that is simple, can be built very light in weight, and should be highly efficient overall.

Reference:

1. Hughes Aircraft Co., *Final Eng. Rept. P64-51 Contract NAS 9-2099*, pp. 41-64.

Note:

Further documentation is available from:
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Patent status:

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