

The output of the optical correlator would be fed to the neural processor for classification and identification of the preliminarily recognized targets. The neural processor could contain one or more analog and/or digital artificial neural networks, which are well suited for identification of targets by virtue of their

fault tolerance and their capabilities for adaptation, classification of patterns, and complex learning. An analog neural processor with a parallel configuration that has been demonstrated to be capable of classifying hyperspectral images and patterns may be suitable as a prototype neural processor for this instrument.

This work was done by Philip Moynihan, Robert Van Steenburg, and Tien-Hsin Chao of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1) NPO-30326

Finned-Ladder Slow-Wave Circuit for a TWT

Impedance and gain per unit length are increased.

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A finned-ladder structure has been invented in an effort to improve the design of the slow-wave circuit of a traveling-wave tube (TWT). The point of departure for the design effort was a prototype TWT that contains a ring-plane slow-wave circuit (see Figure 1). The design effort was a response to the observation that despite the high-power capabilities of the ring-plane TWT, its requirement for a high supply voltage and its low bandwidth have made it unacceptable for use outside a laboratory setting.

Modifications of the ring-plane slow-wave circuit were proposed on the basis of the physics of interaction of the electromagnetic field with this circuit and with the electron beam. The effects of each proposed modification were analyzed by use of the Solution of Maxwell's Equations by the Finite-Integration-Algorithm (MAFIA) computer program — a powerful, modular electromagnetic-simulation code for the computer-aided design and analysis of two- and three-dimensional electromagnetic devices, including magnets, radio-frequency cavities, waveguides, and antennas. For each trial design, MAFIA was used to calculate frequency-vs.-phase dispersion characteristics, and attenuation and small-signal gain vs. frequency. Also calculated were values of the beam on-axis interaction impedance, which is a measure of the strength of interaction between a radio-frequency wave and the electron beam. A nominal operating frequency of 32 GHz was used in the design calculations and numerical simulations of performance.

The modifications that were adopted included an increase in the inner diameter of the outer barrel, introduction of slots into the planes that support the rings, and the addition of metal loading fins. Figure 2 depicts the finned-ladder slow-wave structure that was adopted as a result of the iterated modifications and

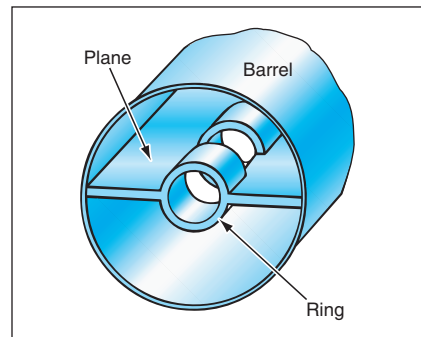


Figure 1. A **Prototype Ring-Plane Circuit** was modified to obtain a finned-ladder circuit.

computations.

The simulations showed that the finned-ladder structure can be expected to exhibit radio-frequency output power of 20 W (corresponding to efficiency of 20.2 percent) and on-axis interaction impedance of 120 Ω at an applied potential of 6.8 kV and nominal operating frequency of 32 GHz, with a half-power bandwidth of greater than 3 percent. The computed gain, efficiency, and on-axis interaction impedance are greater than those of prior TWTs that contain helical and coupled-cavity slow-wave structures, and the applied potential is low, relative to that of a TWT containing a ring-plane slow-wave structure. Moreover, because of the greater gain per unit length of the finned-ladder structure (relative to helical and coupled-cavity structures), slow-wave circuits needed to obtain a given amount of gain could be made significantly shorter.

The overall dimensions of the designed finned-ladder structure are a diameter of 0.093 in. (2.36 mm) and length of 2 in. (50.8 mm). Because of their smallness, it would not be possible to fabricate the disks of the finned-ladder structure by conventional machining. Instead, it has been proposed to fabricate them by batch chemical milling and/or micro-electrical-discharge

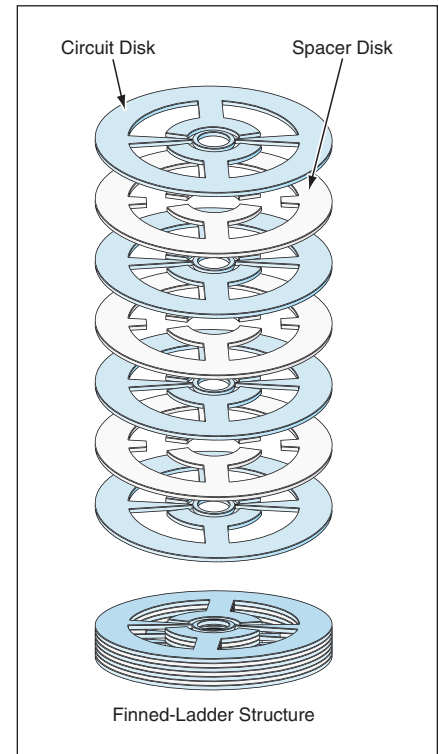


Figure 2. A **Finned-Ladder Circuit** has an all-metal structure comprising circuit and spacer disks. Numerical simulations show that the finned-ladder circuit offers advantages over prior slow-wave circuits.

machining. The circuit and spacer disks would be stacked alternately and diffusion-bonded to form the all-metal periodic finned-ladder circuit structure.

This work was done by Jeffrey D. Wilson and Edwin G. Wintucky of Glenn Research Center and Carol L. Kory of Analex Corp. Further information is contained in a TSP (see page 1)

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