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A Sterilizable High-Impact Antenna

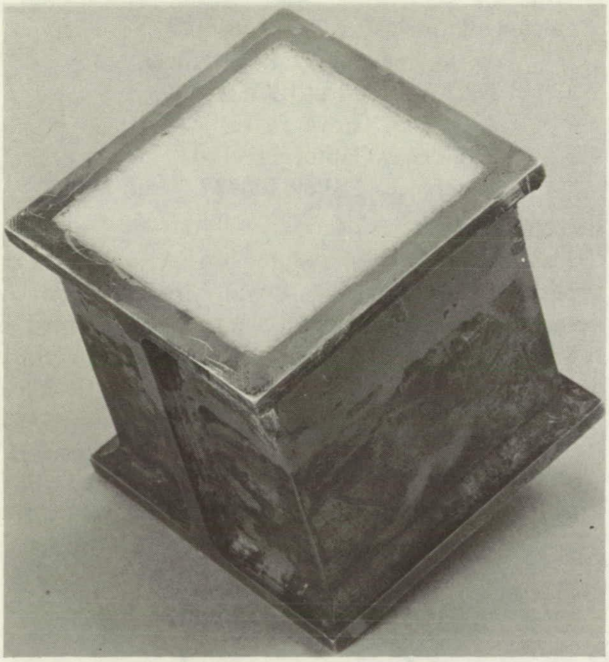

Figure 1(A). Front

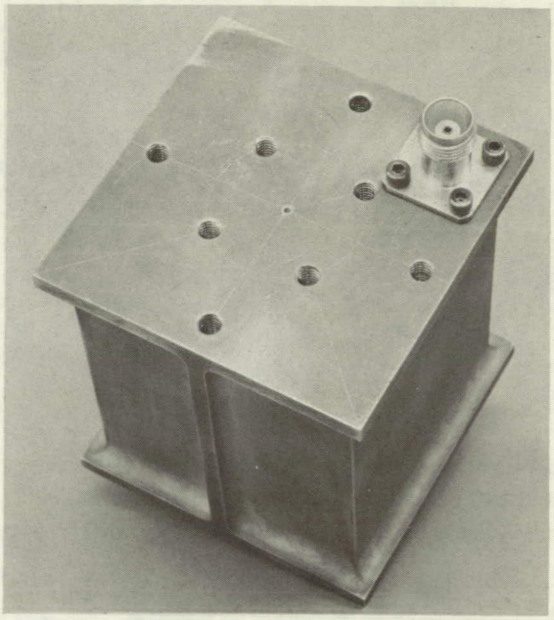

Figure 1(B). Back

A relatively simple, rugged, lightweight rectangular cup antenna has been designed to withstand indirect impacts up to 10,000g and direct impacts up to 250 ft/sec of impact velocity and provide radiation of selected (circular, elliptical, or linear) polarization and beam shape. The antenna is also sterilizable at 275°F. Other features of the antenna are its high radiating efficiency, and relatively broad bandwidth. The antenna is intended to survive crash impacts on space vehicles and beacons. Figure 1 shows an experimental model of the antenna, which was designed to radiate a circularly polarized pattern at S-band frequencies. It consists of an aluminum cup, 2.10 × 2.10 × 2.20 inches, internal dimensions having metallic perturbations along the inside surfaces of two opposite walls. The cup, whose open end defines the antenna's radiating aperture, is excited by a probe that is slanted along one of the diagonals of the cup, as shown in Figure 2. The probe, a metallic rod having a diameter of 3/32 inch, is an extension of the center conductor of the input coaxial connector located at the rear of the cup. The probe is completely imbedded in a commercially available foam-in-place plastic dielectric, which provides an all-around rigid support for the probe and cup

(continued overleaf)

walls. This dielectric material also enables the construction of an antenna of reduced size and prevents the entrance of foreign matter. The cured foam in the experimental model has a density of approximately 30 lb/ft^3, a relative dielectric constant of approximately 1.5, a compressive strength of over 2000 psi, and an excellent adhesion to the cup walls.

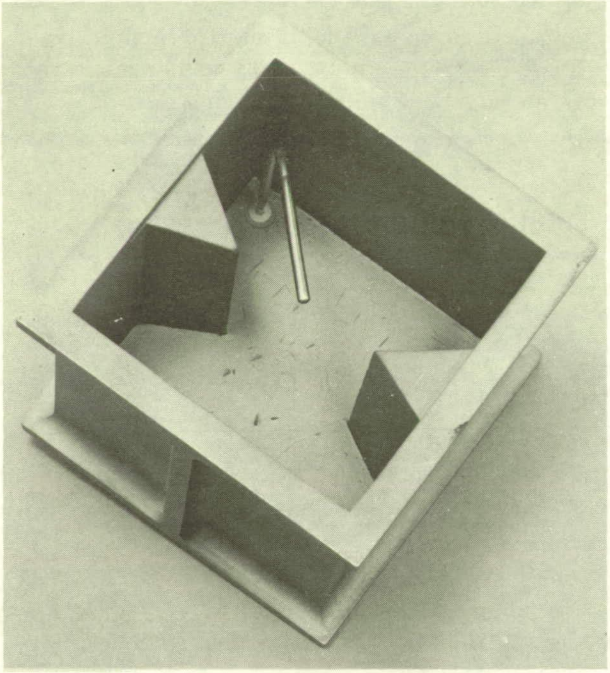

Figure 2. Inside

When microwave energy is applied to the probe, the latter excites the orthogonal rectangular TE_{10} and TE_{01} modes in the cup. Because of the presence of the perturbations in the cup, these two modes propagate with different phase velocities. By properly selecting the cup dimensions, the perturbations, and the probe size, position, and angle of inclination, orthogonal waves of selected amplitudes and phase relationships may be achieved at the cup's open end. Consequently, radiation of a selected polarization is obtained. When the orthogonal waves are of equal amplitude and in phase quadrature at the aperture, the radiation is circularly polarized. By properly selecting the cross-sectional dimensions of the cup, radiation of a selected beam shape may also be obtained.

A coupling loop, in place of the probe, may be used in this design to accomplish the same capabilities of the antenna.

Note:

Documentation is available from:
Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
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Patent status:

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