COMPACT TOP-WALL HYBRID JUNCTION

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Very often in working with a waveguide transmission system, it is necessary or desirable to couple off from the system a specified amount of the energy for various purposes. A common and practical method of accomplishing this is through the use of directional couplers and waveguide hybrid junctions. The hybrid junction, as used in this discussion, refers to a specialized waveguide directional coupler having the characteristic that when power enters one of its terminals this power divides equally between the two forward output terminals. the object of this paper is to describe briefly a compact, broad-band hybrid junction whose high performance and geometry are noteworthy.

The investigation undertaken here was to develop a waveguide hybrid junction between two parallel lengths of waveguide joined together along the common broad-wall surface. Two parallel, rectangular, and identical slots were introduced in this common broad-wall of the waveguide to facilitate coupling. The slots were located adjacent to the boundary side-wall of the waveguide, equidistant from the guide center-line, opposite from each other, and in a longitudinal position. Numerous combinations of various slot sizes were investigated on a standard x-band test bench setup. After carefully restricting the limits on slot dimensions, further tests indicated that smooth tapers introduced along both the broad and narrow walls of this structure improved its performance. Later measurements proved that still further improvement could be obtained by tapering the ends of the slots.

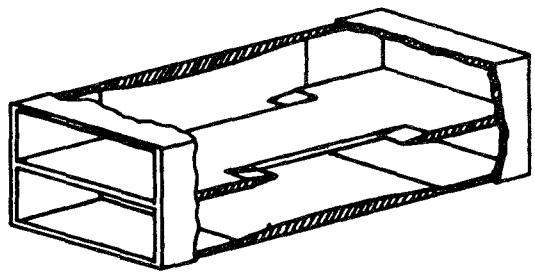
All of these tests were performed on a precision-machined test block comprised of two identically milled U-channels and a removable common center plate. This assembly was dowel-pinned and bolted together for each measurement. The removable center plate served as the common wide-wall between the two sections, and lent itself to the substitution of numerous plates with various slot sizes for relatively rapid testing. This test block assembly was carefully fitted with accurately machined E plane-bend adapters for routine bench measurements. The entire assembly was soft soldered together for final testing.

Over a wide band of frequencies from 8,200 to 10,100 megacycles the following data was recorded; power division to within $\pm$.3 of a decibel, isolation in excess of 30 decibels and a standing-wave-ratio less than 1.07. Across a narrower band from 8600 to 9800 megacycles, power division to within $\pm$.1 of a decibel has been achieved with the high isolation and low standing - wave-ratio preserved. Recent tests on this top-wall hybrid junction indicate its ability to handle peak power in excess of 200 kilowatts. Thus far this hybrid junction is produced by precision investment casting utilizing the lost wax process. It has been possible to cast it in either berrylium copper

or aluminium. Numerous low power measurements on many top-wall hybrid castings indicate accurate reproducibility. Final performance, however, is invariably obtained through a process of individual testing and trimming to obtain optimum characteristics. Figure 1 shows a top-wall hybrid casting with a section of the walls cut away to view the interior structure. The over-all dimensions of this component are 1 3/4 inches long, 1 inch wide, 15/16 of an inch high, and the rectangular slot sizes approximately 1 inch long by 1/4 of an inch wide.

In essence, the top-wall hybrid junction can be considered as a complement to the side-wall hybrid junction, described by Henry J. Riblet.* Their performance and theory are very similar; the fundamental mode of the side-wall hybrid junction is replaced by the coaxial mode in the top-wall junction, and it is believed that this may account for the slightly broader-band performance indicated in figures 2 and 3. These figures represent the best data obtained thus far with models of the top and side-wall hybrids. Numerous applications for this novel waveguide junction exist as in the case of the side-wall short-slot hybrid junction.

* H. J. Riblet, "The short-slot hybrid junction," Proc., I.R.E., vol. 40, pp. 180-184; February, 1952.



TOP WALL HYBRID

Fig. 1

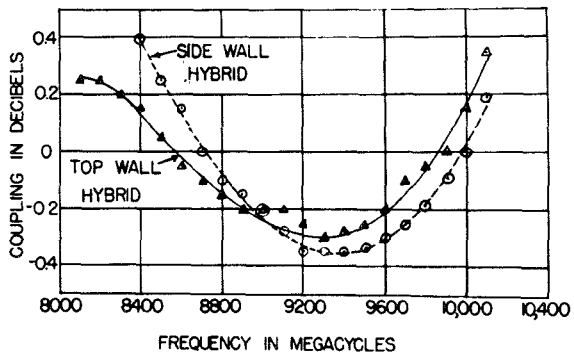


Fig. 2

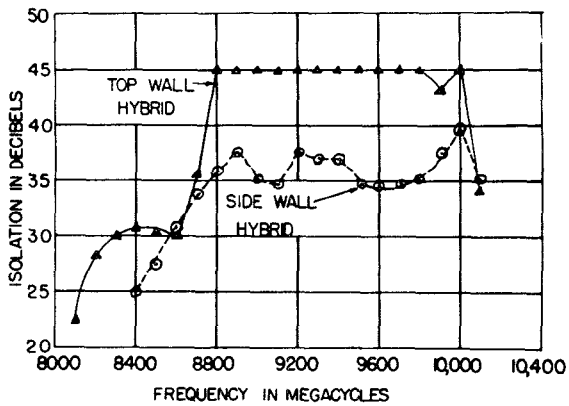


Fig. 3