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NASA TECH BRIEF

Lewis Research Center

High Efficiency Collector for Microwave Tubes

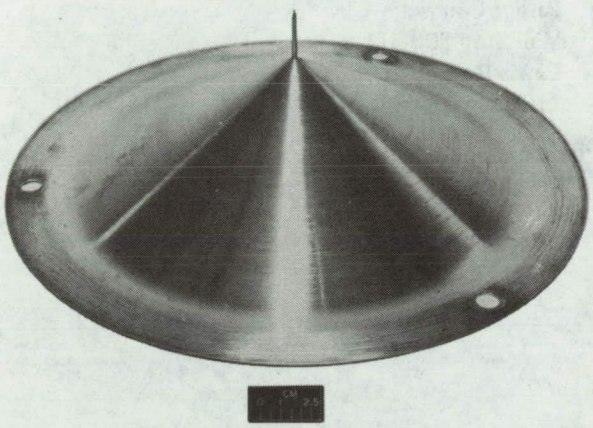

Figure 1

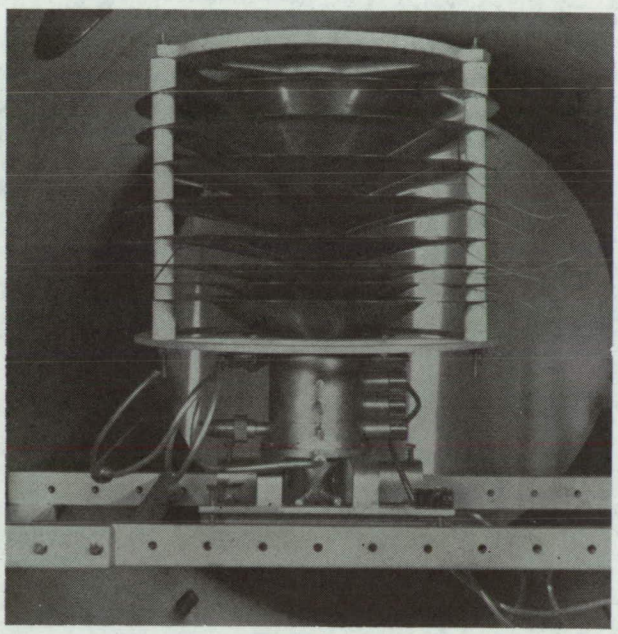

Figure 2

The problem:

The residual energy in spent electron beams emerging from the exits of microwave tubes represents both a loss in efficiency and a heat dissipation burden. For space communication systems, where high efficiencies and minimum cooling are required, recovery of this energy is mandatory. "Depressed collectors" which slow down the electrons and collect them on surfaces at the lowest possible potentials provide this function. Present collectors, however, are inefficient due to excessive backstreaming of slow primary electrons and secondary electrons, and could not be applied to microwave tubes which were themselves relatively efficient.

The solution:

A new depressed collector has been developed; it takes a basic configuration of a dish with a central cone and a protruding spike, Figure 1. This geometry effectively performs three functions at the same time: it velocity sorts the electrons; it slows the electrons down to minimum realizable velocity at collection; and it prevents the backstreaming of secondaries and reflected primaries into the interaction region of the tube.

How it's done:

The collector is actually a series of electrodes, Figure 2, that recovers electrons of varying velocities. The collector works by slowing down the electrons and collecting them on surfaces at the lowest potentials. An accurate and complete achievement of this task is possible only after exact trajectories of the electrons have been calculated. This calculation, in turn, requires an accurate solution of the shape of magnetic and electric potential fields in the presence of a high density space charge flow produced by the electrons. The solution was based on the use of the Green's function method in elliptical harmonics. This solution prevents space charge "blocking," and backstreaming of secondaries because the latter are automatically suppressed by negative electric fields present on the "upper" side of the plates where collection occurs.

Notes:

1. The new depressed collectors will operate at efficiencies in the range of 50-80% even if applied to tubes with basic electronic efficiencies of more than 50%; this sharply contrasts with the collectors used today which cannot be applied effectively to higher efficiency tubes. Overall tube efficiencies up to 75% or higher may be realized with these new collectors which is a substantial improvement over present performance.
2. The depressed collector can find use in microwave power amplifiers in space stations, military and civilian ground installations, TV stations, weather radar and airport radar installations.
3. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA-TN-D-6093 (N71-16585), A Novel, Axisymmetric, Electrostatic Collector for Linear Beam Microwave Tubes
4. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10259

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
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