SIEMENS

YH 1045, a 12-kW High-Power Traveling-Wave Tube for Multi-Carrier Operation in Satellite Communications Ground Stations

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In the new satellite communications systems, it is intended to introduce multiple-access satellites in order to economically utilize the relatively expensive installations involved. Since the high-power amplifier will have to transmit several carriers, each with up to 120 speech channels, and in limited cases more, and possibly an additional television carrier, the output power tube must meet some particularly stringent requirements. It must exhibit virtually uniform transmission characteristics over the frequency band 5.925 to 6.425 GHz for constant operating voltages, good linearity, low intermodulation products [1, 2], and low crosstalk ratio between the individual carriers, i.e. low AM/PM conversion [1, 2, 5, 6].

These requirements are met by the Siemens traveling-wave tube YH 1045 developed from its forerunner types YH 1040 and YH 1041 [2, 3]. This tube is a wideband device meeting the additional requirements of multi-carrier operation.

Design of the traveling-wave tube YH 1045

The YH 1045 is a metal-ceramic tube consisting of several subassemblies as shown by the longitudinal cross section in Fig. 1.

Beam formation and guidance

Unlike the traveling-wave tubes YH 1040 and YH 1041, both of which are focused by periodic permanent magnet structures [3], a solenoid (Fig. 2, right) producing a dc field has been employed for the YH 1045. This has to provide a *constant magnetic field along the tube axis, including the section, which, because of the output waveguide, could not be covered by the coil itself.*

Fig. 3a shows the variation of magnetic field along the tube axis from one coil without iron weighting. The flanks become considerably steeper when the winding is shielded (Fig. 3b), and a partial short-circuit with an iron cylinder levels off the cusp of the curve (Fig. 3c). Finally, one end plate is moved away (Fig. 3d) to make room for the output waveguide. The cooling has considerable influence on the design of the solenoid. Individual disk-shaped coils stacked up on a core form the complete solenoid, between which copper plates with water pipes brazed to their circumference are located (see Fig. 2). The solenoid is magnetically shielded, and produces a 1200 G axial field with a 20% gradient at the collector end of the tube.

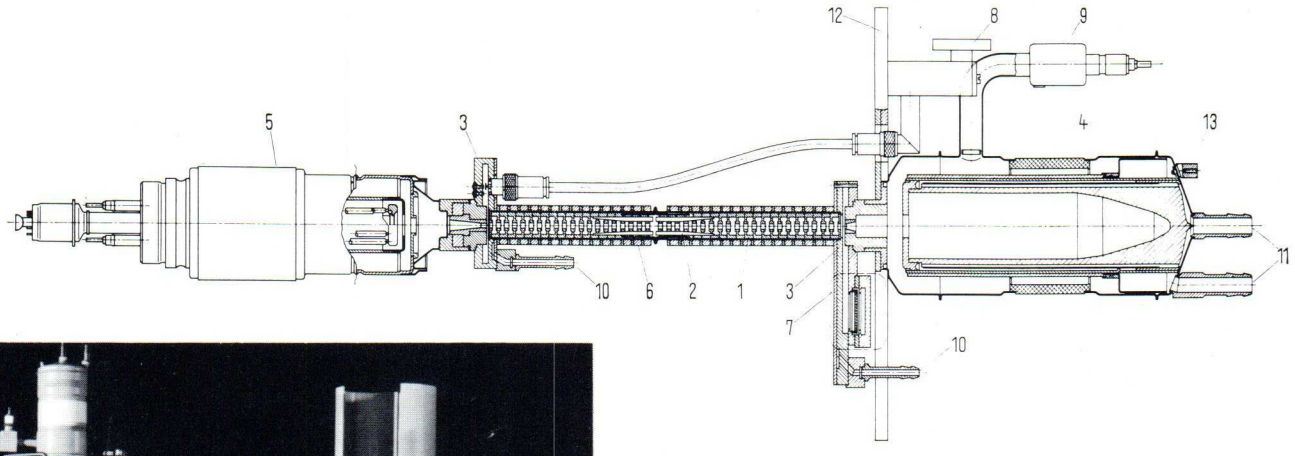

Fig. 1 Longitudinal cross section through the traveling-wave tube YH 1045

1 Delay line
2 Absorber
3 Coupling waveguide
4 Collector
5 Electron gun
6 Field straightener
7 Output waveguide
8 Input waveguide
9 Ion pump
10 Water pipe connections for both sections of the line
11 Water pipe connections for the collector
12 Collector end pole plate
13 Collector terminal

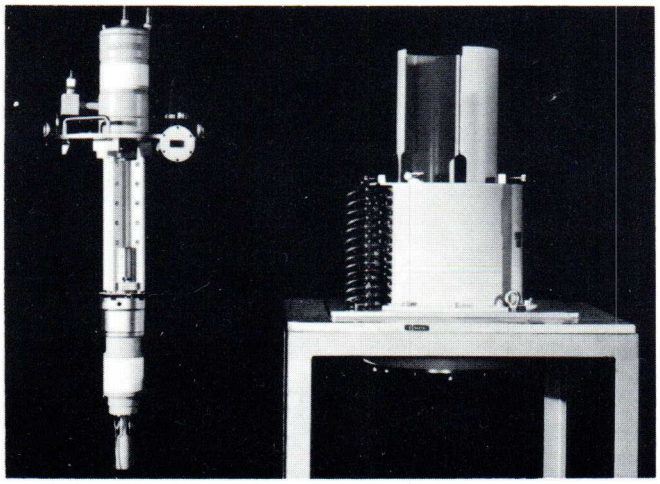

Fig. 2 Traveling-wave tube YH 1045 (left) and associated solenoid MS 1045 (right)