Magnetron-Like Devices: The Phasitron

The phasitron is a vacuum tube, designed to operate as phase modulator in FM transmitters, that uses the interactions of electrons with combined electric and magnetic variable fields. Robert Adler of Zenith Radio first introduced the device in January 1946. In the years General Electric produced a couple of tubes based on its operating principle and used them in commercial FM transmitters. The two known devices are 5593 and 2H21.

Fig. 1 - General Electric registered two devices, the 2H21 and the 5593. Here the photos of the two phasitrons with details of the electrode structure inside.

The structure of this tube generates a rotating undulate electron disk, as in the figure below.

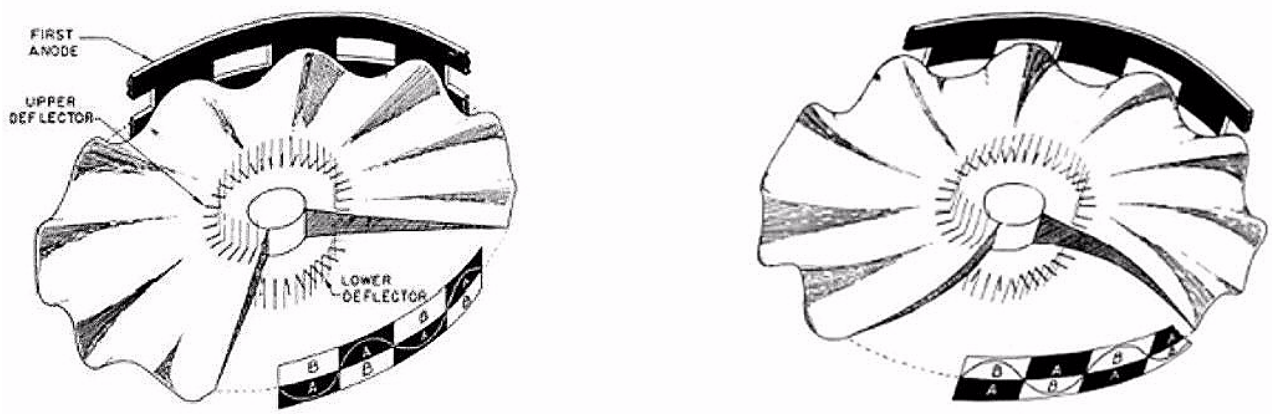

Fig. 2 – Perspective view of the ruffled electron disk, deflected by the radial deflecting rods.

Electrons emitted from the cathode are first focused in a sharp-edged disk and then pass through a deflection system, formed by two parallel circles of radial rods, connected into three interlaced groups and driven by a 3-phase RF source. As result, electrons are forced to move as a rotating undulate disk that is intercepted by the anode system formed by two coaxial anodes, anode No. 1 having twelve holes punched above the plane of the disk and twelve holes punched below. Due to the holes in the first anode, from time to time the rotating electron disk impinges on the first anode

or, passing through the holes, reaches the second anode. The current flowing to the second anode will be sinusoidal at a frequency related to the one driving the deflecting system. Now, if a variable magnetic field is applied perpendicularly to the plane of the electron disk, an angular displacement is introduced in its rotation, causing a phase shift in the output current.

In the actual phasitron, just one set of radial rod is used, the upper one being replaced by a neutral plane. The modulation coil is mounted all around the glass envelope of the tube. A cut-away view of the tube, mounted inside the coil and connected to the external circuits, is shown in the figure below.

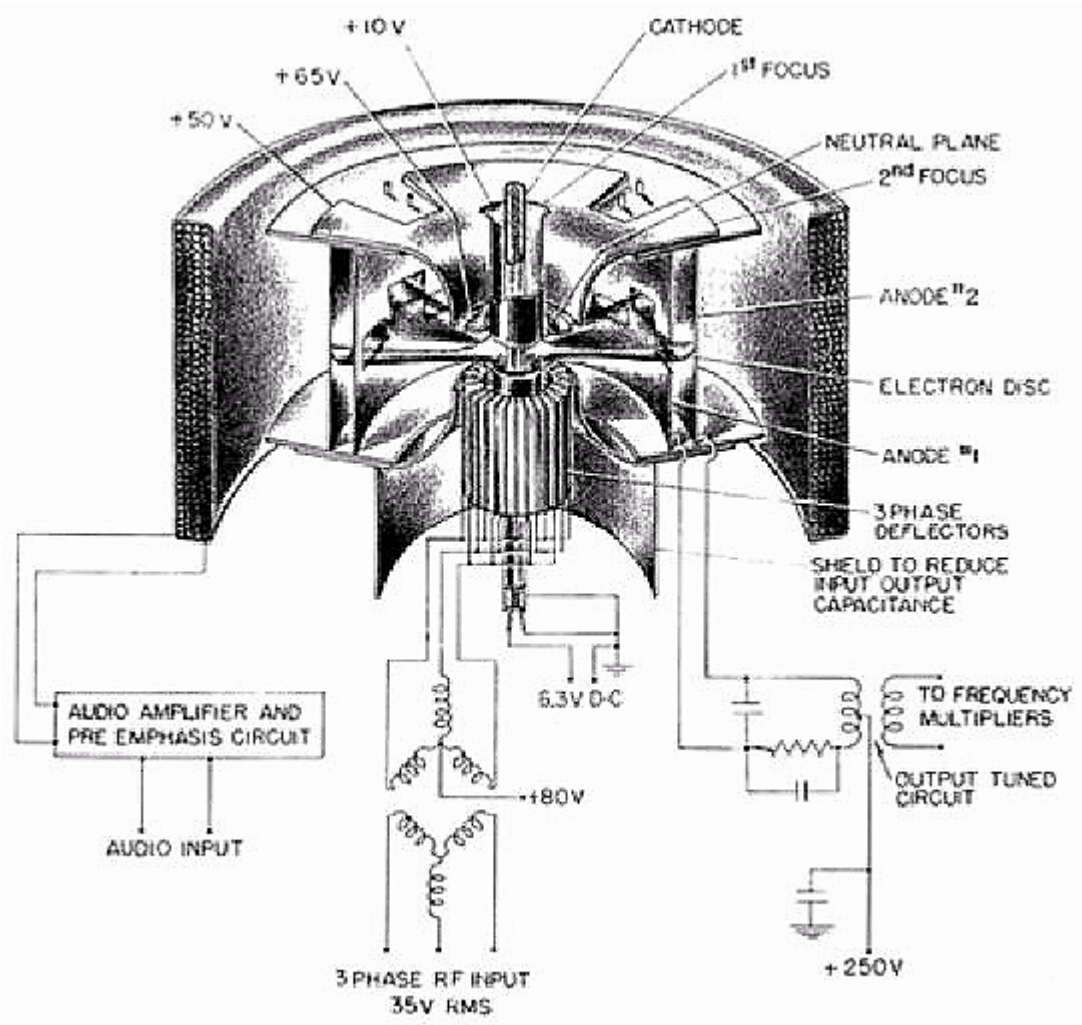

Fig. 8 – The phasitron electrode structure with connections to external circuit blocks.