8.1 – Temperature limited diodes, noise sources

> Back to main index < > Go to the noise source index <

Noise sources were used to evaluate the performances of receivers and of amplifiers by measuring the noise level required into the antenna or into the input terminals to overcome the noise of the device under test. Noise sources were also used in electronic countermeasures to jam any hostile emission in a given frequency spectrum.

Many devices were used in the years as noise sources, among which temperature limited diodes, gas-filled diodes or even thyratrons, photomultipliers, trachotron counters and magnetron tubes. Of course for any given device, but for a few specialized ones, the border line between the behavior as noise source and a more conventional operation is not well defined. According to an investigation of MIT during WWII, Microwave Receivers by Van Voorhis, some triodes with tungsten filament, as 15E or 708A performed well as noise sources for testing radar IF amplifiers, while the gridless variant 15R was unsatisfactory. The 6D4, proposed by Sylvania as miniature gas relay, soon became one of the most known noise generators. Even magnetrons or trochotrons, whose typical operation is based upon given relationships between electric and magnetic fields, were sometimes used as excellent noise sources by driving them near cutoff. No wonder then to find in this section, among specific devices also tubes listed elsewhere.

Temperature limited diodes, with filamentary tungsten cathode, were commonly used as current sensors in voltage stabilizers, since by the Richardson emission law their emission and then their plate current is proportional to the current flowing into the filament. When operated at saturation, under the temperature needed to reach sufficient emission to form the space charge smooting cloud, these diodes are usable as noise sources. Noise is the result of what is referred to as shot effect, a fluctuation of anode current due to the random impact of electrons leaving the filament surface. Of course some devices were specialized as per plate power dissipation, useful spectrum or even interface to coaxial transmission lines, as the CV2341.

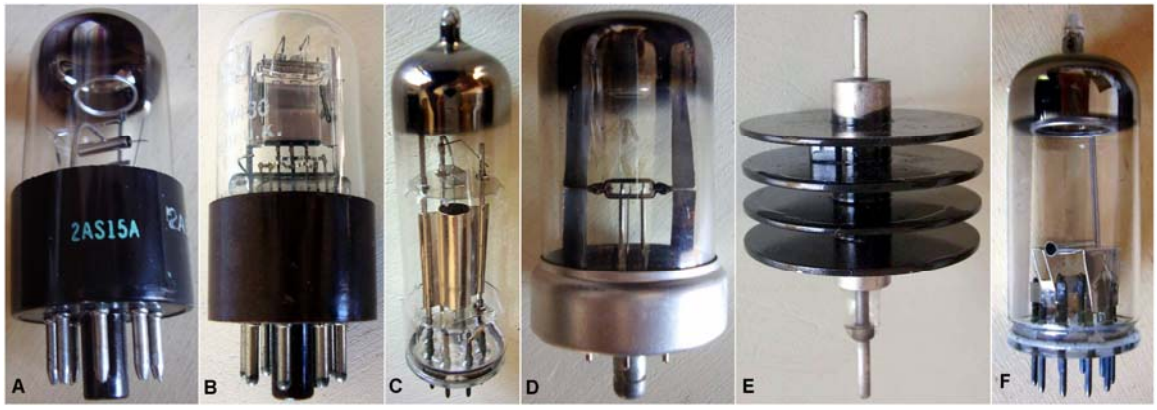

Fig. 8.1.1 - Temperature limited diodes. Three devices intended for use as sensors in voltage stabilizing circuits on the left are shown beside three diodes designed to operate as noise generators, to show the similarities in the basic structure for most of them. A) 2AS15A was a temperature limited diode used in AC voltage stabilizers by Sorensen and Superior Electric. With the exceptions of the backelite base and the lenght of connections its electrodes look very similar to those of K81 noise source (F). B) CV430 was a British temperature limited diode for voltage stabilization circuits. C) Also Philips 56001 was specified for operation in AC/DC voltage stabilizers. D) British GEC E.1478, approved as CV172 was considered the best noise source in WWII. Plate heat was radiated by two large vertical fins. E) British Marconi CV2341 was designed to be fitted in a coaxial mount. Its noise was usable up to 1 GHz. F) Philips K81A was a noise source useful up to 300 MHz. (Click to enlarge)

Operating principles of gaseous noise sources were based upon the random scattering of electrons due to direct hits with gas ions encountered in their travel to the anode. The probability of hits

increases with the length of the trajectories followed by electrons. For this reason the gaseous noise sources are usually long tubes with anode and cathode at opposite ends. In the case of the 6D4 thyratron the electron trajectories are artifiacially lengthened, forcing them to follow spirals in the space from grid to anode, by action of a magnetic field superimposed to the electric field.

Noise generated by electrons which impact tangentially the anode, having been forced to follow curved trajectories, is also used in some specialized vacuum tubes, some Russian vacuum diodes with cylindrical electrodes, magnetrons and trochotrons. Magnetrons were particularly attractive for use in ECM jammers because their capability to directly fed high-power noise into the antenna. General Electric patented a magnetron noise generator tube derived from split-anode types, patent US3958148 A. Even trochotron counters were used to generate noise. Probably in the early series of ALT-14 the same 6700 decade counter was used for a while, and anode, grid and spade voltages were so set to skip stable states. Anyway Burroughs introduced two trochotron devices specialized for operation as noise source.

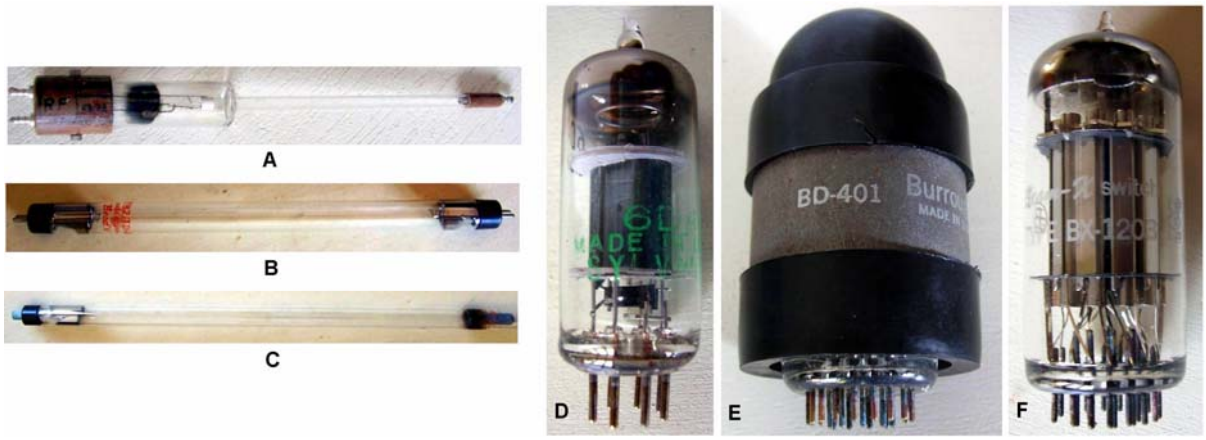

Fig. 8.1.2 - Tubes designed for use as noise sources. A) British CV2479 was effective over an extremely wide noise spectrum, from 7 to 40 GHz. B) Bendix argon-filled TD-22 was used installed in a waveguide mount to cover the S-band. C) TD-10 could generate noise from 3.95 to 8.2 GHz depending upon the waveguide mount. D) 6D4 gas triode was used as noise source up to 5 MHz, mounted inside the pole pieces of a magnet. E) BD-401, registered as 6702, was proposed as noise generator effective up to 400 MHz. F) The electrode structure of BX1203 / 6713 is modified, leaving two targets and the corresponding four leading and lagging spades, so to generate an eight-shaped asymmetry for electrons following trochoidal trajectories in the interelectrode field. (Click on the image to enlarge)

> Back to main index < > Go to the noise source index <