11. - Special tubes, phasitron, chronotron, didactic and experimental tubes

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Here we find vacuum tubes which cannot be otherwise classified, due to their operating principle or to their non-conventional applications. Of course some vacuum tubes listed here could also be found in other sections, depending upon their usage in certain of the otherwise existing families. We will examine some of them.

11.1 - Phasitron

Phasitron™ is a vacuum tube designed to operate as phase modulator in FM transmitters. It uses the interactions of electrons with combined electric and magnetic variable fields. It deserves few words because of the ingenuity of its design. Robert Adler of Zenith Radio first introduced the device in January 1946. In the years General Electric manufactured a couple of tubes based on its operating principle and used in commercial FM transmitters. The structure of this tube generates a rotating undulate electron disk inside the variable magnetic field of a modulation coil, as better explained in the article **'Magnetron-Like Devices: The Phasitron'**.

Fig. 11.1 - The collection includes both the types made by General Electric, 2H21 and 5593.

11.2 - Chronotron

Strictly speaking chronotron devices cannot be defined vacuum tubes. The Bendix 'Chronotron' contains two separate heaters, each thermally coupled to a thermistor. The device was intended to compare the rms value of two arbitrary waveforms or of an arbitrary waveform with a DC reference by comparing their thermal effects on the associated thermistors in a balanced circuit. It can also be used as a controlled delay element in very low frequency oscillators.

Fig. 11.2 – A sample of the chronotron TT-15, with 130 s time constant.

11.2 – Telephone repeater tubes

These tubes were designed, manufactured and screened for many years of stable and uninterrupted operation in undersea repeaters. Of special interest are the Bell 175HQ, ultra-high-rel amplifier used in the TAT system, and its successor, the Bell 455A. These tubes were designed for hard to believe life span, in the order of fifty centuries, to ensure 20 years uninterrupted system life.

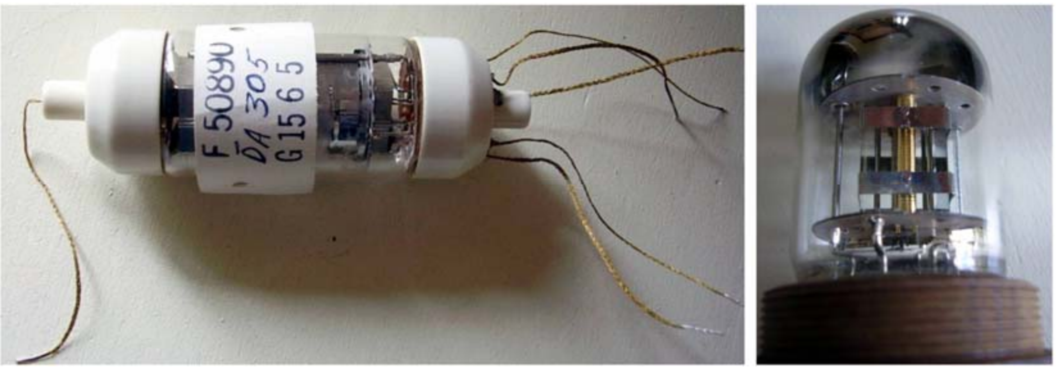


Fig. 11.3 - The Bell 175HQ, used in the transatlantic telephonic system TAT and its successor, the 455A.

11.3 – Didactic and lab tubes

Here we find few tubes used to perform experiments in physics laboratories.

Fig. 11.4 - These tubes were quite common in the physics laboratories of technical schools in the twentieth century. From left, a BR-2 Braun cathode ray tube, an SKR-2 electron-flow windmill and a GRD7 symmetrical temperature-limited diode.

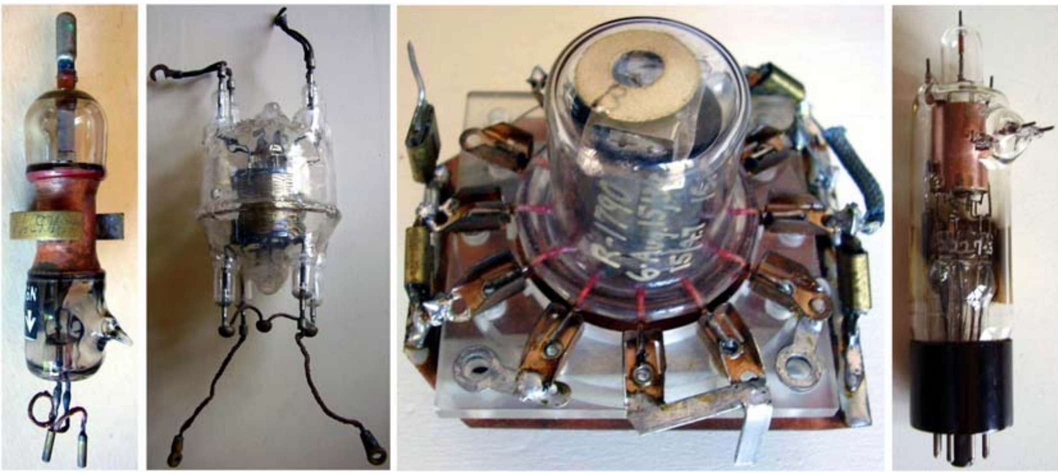
11.3b - Experimental tubes

The collection also includes samples of experimental tubes. Here we find types which never reached production and types developed for military applications during the war, some even listed in the CV register, but only used in the development of new systems, with no further production or use. Most of them are undocumented at all.

Worth of notes are some experimental interdigital magnetrons built by GEC, one with eight and one with twelve segments. We also find a very early Sperry klystron, similar to the prototypes used by Varian brothers in their experiments at Stanford University, and a British power klystron, the CV150, which never reached production.

- Fig. 11.5 - Samples of GEC experimental magnetrons, 8 and 12 segments. Sample of early Sperry klystron of the type used in the experiments of Varian brothers at Stanford. Sample of CV150. Click to enlarge.

Some more samples are related to the development of radar before and during the war. Among the others we can find the CV8 TR switch, a vacuum diode for coaxial lines which failed to effectively protect the mixer from RF pulses. Another interesting and undocumented tube is the CV14, a silica triode developed around 1940 to be used in high power radar transmitters. Quite interesting is also the RCA R-1790, an early protorype of the 1630 orbital-beam hexode used in the VHF front end of the receiver in the SCR-270 radar. Another weird tube is the RCA A-1306B which recalls some details of the electrode arrangement used in the 1636 beam deflection heptode.



- Fig. 11.6 - From left: CV8 TR proved to be unable to effectively block RF pulses. CV14 was tried as high-power variant of NT57D. R1790 led to the production of 1636 giant acorn. RCA 1636 looks to be a beam deflection tube. Click to enlarge.

Moving to other types of tubes, the collection include a prototype of GEC power catkin which can be dated to the early thirties and a sample of a special CRT used to probe magnetic fields, probably made by RCA in the late thirties. A couple of National Union developmental millimicropups, the 3C27 and the 3C27B never reached in-field use during WWII, replaced by the improved 3C37.

Other samples can be dated around the fifties and even later. They include a tiny National Union CRT, a couple of photomultipliers, a Sperry klystron frequency tripler and a Philips Omegatron device, a mass spectrometry sensor. Special mention is reserved for a British Mazda developmental prototype, the VX6122, which looks to be a high-current rectifier, maybe for airborne applications due to its compact size. Nevertheless it could well deserve the place of honor in any museum of moden art for its internal look.

- Fig. 11.7 - Bottom view of the Mazda VX6122 experimental rectifier. Click to enlarge.

11.5 - Special tubes for weapons

This section includes some very special devices intended to operate inside weapons. We find some subminiature tubes designed for active fuzes or torpedo guidance and a SAD fuse.

Fig. 11.8 - Samples of vacuum tubes specifically designed for weapons. From left, a 2D29 subminiature thyratron used in the T-172 proximity fuze, Raytheon CK1306A and CK1307A, believed to come from the active sonar search head of early Mark 44 torpedoes, and the NEC M-999 thermal cutoff, used as SAD in a torpedo guidance board.

These tubes were designed for the control guidance of missiles and torpedoes, but even to trigger proximity fuses in ammunitions. They had to operate in extreme environmental conditions, mainly as per acceleration and vibration. Even if the operating life was very short, their had to operate reliably after years of storage. The most critical features of these tubes were:

- Very low size and mass, even to better handle heavy accelerations.
- Extremely rugged construction, to withstand accelerations as high as 20.000g.
- Very low noise and microphonics.
- Ultra fast heating time, to have the weapon operating as quickly as possible.

Unfortunately very few information are available for these tubes and even the same code is often omitted.

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