DEVELOPMENT OF THE TM TYPE VALVE

by PETER HADGRAFT

THE ENGLISH PHYSICIST J A Fleming worked as a consultant for firms such as Edison Telephone and the Marconi Company. In 1904, experimenting with 'Edison Effect' bulbs imported from the USA, he developed a device he called an 'oscillation valve', a diode. De Forest invented the triode tube in 1907.

These soft valves, with poor quality vacuum, were not reliable and reproducible, but very sensitive when they could be made to work as required. Typically, an arm in the side of the soft valve envelope contained asbestos. A little judicious heating of the arm released gas as required. This was an art, not a science, and a radio operator had at least two valves available in case one did not work when required. The soft valve needed to be large, so small changes in gas volume and temperature did not quickly affect gas pressure and thus valve performance. It was typically used as an amplifying detector or local oscillator, but was limited to less than 80 volts on the anode to avoid gas ionization.

H Arnold at AT&T developed high vacuum triodes in 1913, using De Forest's patent and Gaede's diffusion pump, for the company's telephone line amplifiers. Initially these had no base, but the type M in 1914 had a skirt and base with 4 pins and a coated tungsten filament (based on the Wehnelt cathode, 1904). Its life was 1,000 hours. Langmuir at GE laboratories Schnectady, NY, improving in 1915 Gaede's high-vacuum diffusion pump (1912), developed a series of Pliotrons including a triode with a hard vacuum.

The hard valve was reliable and had reproducible characteristics. It could be used with anode voltages above 80 volts. However, it did not have the gain of a soft valve. It required several hard valve stages to produce the same gain as one soft valve.

In 1904 Lt-Col. Gustave Ferrie of the Telegraphie Militaire had set up a radio station at the Eiffel tower, and later a large group of top French physicists and engineers. He placed Lucien Lèvy in charge of the TSF (Telegraphie Sans Fils) Centre Radiotelegraphie Militaire laboratory. Lèvy was a businessman and inventor who rightly has claim to the development of the superheterodyne (patent Aug 1917), based on the concept proposed by Meissner (1914) and Laut (1916), and before Armstrong (patent Dec 1918).

Ferrie travelled to USA in early 1914 looking for telecommunication ideas, knowing that war with Germany was inevitable. He saw a three-stage low frequency amplifier, with De Forest audions, being used by Fessenden for underwater sound detection. He had one of these amplifiers purchased. It sat in a storehouse basement until after the war started, when he was reminded that it existed.

The Frenchman Pichon had been working in the patents section of German Telefunken since 1912. He travelled to USA where he collected information and samples of triodes and returned to France just after war was declared in August 1914, being a French army deserter, he was arrested, whereupon he explained what he was carrying in his luggage. This information was passed to Ferrie, who had Pichon and his luggage brought directly to Ferrie's headquarters. French physicists Biquet and Peri at Lyons quickly developed the TM type triode hard valve based on Pichon's samples. They were produced from 1916 for the Allied effort in the Great War, initially by the Sociètè Grammont at Lyons (TM FOTOS valve) and also later the Compagnie Generale des Lampes in Ivry, Paris (TM Metal valve). Ferrie's group also developed a number of military multi-stage TRF valve receivers, which included RF stages, AF stages, grid detection and RC audio coupling.

The TM valve had a round glass envelope, horizontally mounted coaxial electrodes (up to then most valves had parallel plane electrodes), straight-line filament, spiral grid and cylindrical anode, a copper metal skirt, and crucifix 4- pin base, with bifurcated pins. The valve had a tungsten filament operating at 4 volts 0.75 amp, an amplification factor of 10, and transconductance of 400 micromhos. Initially, its life was about 100 hours. The author could find no information on the use of getters with the TM, but photos suggest getter was used with the TM Fotos. 100,000 TM valves were produced from 1916, up to 1,000 per day at war's end. The valve was adopted by Allied armies up to the end of 1917, including the famous British R type valve, a copy of the TM type. It was produced by several British companies from 1916.

Although the AT&T M valve had beaten the French to the design of the forerunner of the modern plug-in hard triode, the TM valve must be seen as an important well-designed contributor to winning the Great War.

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