## History of Electron Tubes Edited by S. Okamura In English (1994)

## 1.2.3.: Early Stage of Development of vacuum Tube in Japan 2 pages (p.p.: 25-26)

As the result of the treaty which was concluded at the 1<sup>st</sup> International Wireless Telegraphy Conference in Berlin in 1906, public communication between land and ship started and in May, 1908, a wireless telegraphy station started in Choshi, Japan.

In December of the same year, an audion tube was used for an experimental communication test between Choshi and Hawaii. This was the first experiment using an audion in Japan, and this audion was one Mitsuru Saeki (who was an engineer in the Ministry of Post and Communication) obtained from a ship's communication engineer who had purchased it in America.

From then on research and development into triodes began in the Laboratory of the Ministry, and in 1911, a triode was successfully made, and subsequently, a larger one was attempted.

At the same time, Uichi Torigata who had studied in Europe and America obtained an audion and sent it to the Electrotechnical Laboratory in Japan, where Eitaro Yokoyama, Seijiro Kitamura, Noboru Marumo et al. conducted experiments on it. As a result, they discovered that the sensitivity was good, but that a large quantity of gas evolved and the audion could not maintain the highest sensitivity for a long period of time, making adjustment difficult and its life span short. Thus, they found it difficult for practical application.

At first in the Electrotechnical Laboratory, only a few experimental models of an audion were made. But in 1915, AT & T of the USA succeeded in communication between New York and San Francisco and Paris and others, using several hundreds of small vacuum tubes connected in parallel. This news made them admit to the importance of the vacuum tube and in 1916 in the Electric Research Institute research was reopened. The following January a test reception using an experimental model of the vacuum tube was made by Kitamura and Marumo, with good results.

In 1917, Tokyo Electric Company completed the first audion in Japan as a manufacturer. From 1919 to the spring of 1920 the results of the experiment of domestic

triodes which they could obtain at that time were reported, entitled "About Domestic Triode Vacuum Tube"\*<sup>1</sup>, in the Journal of the Institute of Electrical Engineers of Japan in July, 1921 by Hidetsugu Yagi, the member of the institute. The tested vacuum tubes were sixteen in all, which were 6 of T Company, 2 of NM Company, 4 of A Company, 2 of O Company and 2 of JN Company. Among them, 2 of T Company and one of A Company were for transmitters and characteristics up to the plate voltage of 500V were measured. The remaining 13 kinds were used for receiver and the measurement were made up to maximum plate voltage of 45V.

The report describes that in those years five companies in Japan made triodes and among them two made transmitting tubes. Because there were several patents concerning vacuum tubes as mentioned above, each manufacturing company concluded patent license agreements or technical agreement including execution of patent right with the patentees in order to manufacture vacuum tubes. Furthermore, several kinds of electron tubes as described later were invented in various countries, and each time manufacturers concluded the agreement before starting domestic production. Most of the newly invented kinds of tubes were domestically produced soon after their invention.

As a result of this introduction to the foreign technologies of electron tubes, in 1930 most of the technologies were learnt and tuned into original inventions. For example, in the same year, 1930, when Zworykin of the USA invented the image orthicon, the storage type picture transmission device which is the original model of the picture pickup tube and led to the advance of television of nowadays, Kenjiro Takayanagi invented a separately similar integration type television image transmission device.

Owing to this technical advance, even after the outbreak of the Pacific War in 1941 and information from overseas came to a halt, new electron tubes were developed successively. However, though the technical level of electron tubes was elevated, the technical level of raw materials and precision processing was rather behind, and when the war came to an end the difference in technical levels with western countries had been increased again. Therefore, even after the war, several patent license agreements or technical assistance agreements were conducted between manufacturing companies in the USA and in various other countries. In 1970, original inventions gradually increased and became free of foreign input and influence.

Note: \*1: The whole report is shown as (002W) here--- Ed..