M-16 CSF Experimental Magnetron

This magnetron was found in February 2024 with other experimental samples coming from the GEC Research Laboratories. Twelve anode segments are arranged to form a typical ‘squirrel-cage’ cylinder which measures about 15 mm diameter by 18 mm lenght. The segments are terminated alternatively to two lateral rings which are connected to the two top pins. The cathode is a cylinder of approximately 3 mm diameter, between the two octagonal-shaped end plates. The cathode cylinder is terminated by small ceramic spacers. The magnetron features some remarkable solutions among which the use of a large surface unipotential cathode.

The glass bulb is considerably darkened as the tube was operated for a long while at very high power. Other signs of prolonged use at the limit of power are given by the almost total lack of the getter on the inside surface of the glass bulb and by the apparent lack of oxide on the surface of the cathode cylinder.

In order to better date this sample, we must bear in mind the parallel development of the French magnetron by Henry Gutton. From the recent article ‘The cavity magnetron. not just a British invention’ (*1) we know of the meetings and exchanges of information between Megaw and Gutton, who was developing his M-16 magnetron at the CSF. In 1937 Megaw successfully tried a large surface emitter in his four-segment E880 design, a thoriated-tungsten cathode whose surface had been increased wounding the wire as a spiral (*2). He advised Gutton of the power increase made possible by this solution. Early in 1939 Gutton was obtaining about 50 W from his M-16 with spiralled wire cathode. Then he decided to try oxide-coated unipotential cathodes with impressive results. During a Megaw's visit in June 1939, Gutton showed him a sample of the M-16 generating pulses of 300 W thanks to the oxide cathode. He promised Megaw samples of the new variant. Our sources jump to May 9, 1940 when, while the Germans were occupying France, Maurice Ponte brought two samples of the M-16 promised by Gutton to Megaw almost a year earlier.

Although no code or constructors can be read on our sample, it looks very well done, with a complex and sturdy harness tightly clamped to the bottom glass column and the U-shaped ribbed terminations which held electrodes in place. The octagonal-shaped end plates and the same shape of cathode cylinder are all typical of the CSF M-16. Few doubts then that it is a CSF magnetron, a 12-segment variant of the 8-segment M-16, as it appears in the available images.

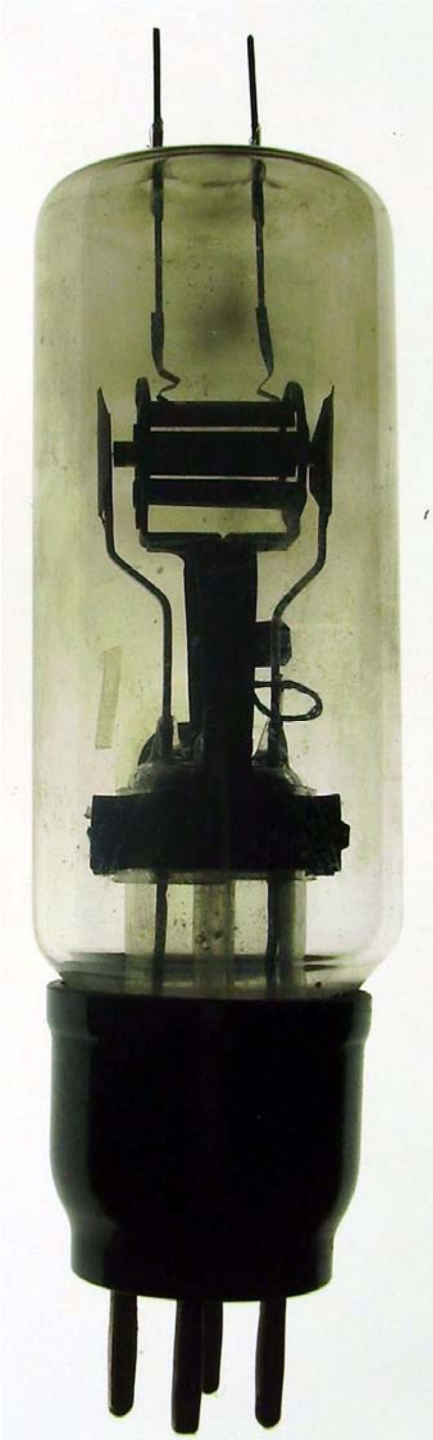
As said befor, our sample is heavily darkened, as if it was operated under extreme conditions. The fact of being together with other experimental magnetrons designed by Megaw at GEC and the evident heavy use, as if to test its limits, and even the rather crude and hasty solution of using octagonal end plates on the sides of the twelve-segment anode make us believe that this sample is one of the two designed by Gutton specifically for his friend Megaw and brought to England by Maurice Ponte in May 1940 (*1,*3). Megaw was just designing the E1189, his low-profile version of Randall and Boot's cavity magnetron, when he launched the oxide-coated unipotential cathode variant. In fact we know that the E1189 S/N 1 came out with thoriated-tungsten filamentary cathode, while the second sample, S/N 2, was fitted with oxide-coated cathode. Bench tests began for both at the end of June and the S/N 2 soon demonstrated its superior emission, with peak power reaching 10 kW. The oxide-coated cathode was just working up to expectations in the E 1190 milli-micropup triodes for the 25 cm AI under development, but no one could know whether it could work as well in a magnetron, under the effect of back bombardment. With the enormous pressure that the Air Ministry was putting on anyone capable of supplying transmitting tubes suitable for an RDF system operating at no more than 10 cm, Megaw had little or no time to waste in conducting normal tests to verify whether the new solution was efficient and reliable. He had to decide quickly wether to change a project that was still only on paper and introduce variations not yet tested. Then he had to stress the samples that Gutton had sent him well beyond their limit, to be sure that the oxide cathode could operate without damage under high-energy pulses. This could explain the visible blackening of the glass bulb and the other signs of wear on our sample.



The sample was bought on eBay UK. It is the third tube of the lot in the photo below, followed by two GEC magnetrons, prototypes of the E880/NT75 designed by the same Megaw in the 1930s.

The images below, courtesy of Yves Blanchard, represent the construction details of two eight-segment M-16s, the first with side anode connections and the second with top pins and flying wires for the heater and the cathode. The latter one was in the collection of the late Rodney Burman.

Images of our sample are given below, to quickly compare the relevant details which led us to the positive identification of the sample as a CSF M-16, although it came with other GEC experimental magnetrons. In particular we note the ribbed metal arch that supports the ends of the anodic squirrel cage, tightened with a flange to the glass column at the base. Other distinctive details are in the dimension and shape of the cathode cylinder ending in two ceramic spacers and in the octagonal shape of the side shields.



1) Y. Blanchard, G. Galati, P. Van Genderen - The Cavity Magnetron: Not just a British Invention, 2013
2) E.C.S. Megaw, High-power magnetron, a review of early experiments, 1946
3) E. C.S. Megaw, W.F. Willshaw - An aarly application of decimetre waves to communication between ships. Atti del Congresso internazionale per il cinquantenario della scoperta marconiana della radio, Roma 1947
4) E. Ciardiello - The development of E1189, the 'British cavity magnetron', 1922