VI. MAGNETRON DEVELOPMENT

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Introduction. The following closely related subjects are being investigated by the Magnetron Development Group.

(1) The construction of a 10-Mw pulsed magnetron at 10.7 cm.

(2) The fabrication of a suitable output window for waveguide coupling of the magnetron, capable of sustained operation at an average power of 10-20 kw.

(3) The design and construction of a cathode free from the sparking or arcing troubles encountered with oxide cathodes at high voltages and currents.

(4) A study of the mechanism of mode jumping observed as the power output of a magnetron is increased.

(5) In conjunction with Item (4), a study of the buildup of oscillations in a given mode from the random noise generated by the space charge.

(6) A study of the noise generated by the space charge in a cavity magnetron at voltages and currents below which coherence in the space-charge structure may be observed.

Progress on the items enumerated above is detailed in the sections below.

A. TEN-MEGAWATT MAGNETRON

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A vacuum-tight high-power magnetron has not yet been made, although it is believed that satisfactory solutions have been found for the difficult mechanical problems involved. Two tubes are now being assembled and construction of several additional tubes has been started.

B. CERAMIC WINDOWS

Staff: D. L. Eckhardt

Two vacuum-tight ceramic windows $3\frac{1}{2}$ in. in diameter have been made. The ceramic was silver-soldered to a kovar cup by using the General Electric

titanium hydride process in vacuum. One of these windows was sealed to a metal container, evacuated and then subjected to heat cycling by heating to 450°C and then cooling to room temperature. After several such cycles, the ionization gauge indicated a pressure of approximately 10^{-8} mm of Hg in the container.

The strength of the metal-ceramic seal was tested by attempting to push the ceramic out of the kovar cup with a hydraulic press. The ceramic broke under pressure leaving the kovar-ceramic joint intact. The $3\frac{1}{2}$ in. window will withstand a hydrostatic pressure of approximately 200 lb/sq. in.

C. THORIA CATHODES

Preliminary measurement of the thermionic constants of a compacted thoria cathode composed of 33 per cent tungsten and 67 per cent thoria have been made under d-c and pulsed conditions. This work is reported elsewhere in this report (see Sec. IA).

D. MODE SELECTION

Staff: R. R. Moats

Necessary equipment to test the voltage-scaled rising-sun magnetron at variable pulse lengths up to 70 μsec as discussed in the last progress report has been completed, and has been used to test the mode-shift characteristics of the tube. A probe assembly has been constructed for identification of the observed modes.

Measurement of the electronic admittance of the QK61 over the range of voltages used in the study of mode shift reported in the Progress Report of October 15, 1947 is also being undertaken for correlation with that work.

E. R-F BUILD-UP TIME

Staff: W. Rotman

Experiments discussed in the last progress report have been repeated using only a matched load for the magnetron, since power reflected from a non-matched load alters the apparent starting characteristic.

Values of the electronic conductance of the QK61 have been obtained as a function of r-f vane voltage and compared with those obtained under c-w conditions over the same range of voltages. The correlation is fair and probably justifies the assumption that the quasi-steady-state approximation used to predict transient characteristics is justified.

The sensitivity of present oscilloscope systems does not allow observation of the r-f transient voltage at a power level below about 5 watts. Since the noise power in the pre-oscillating magnetron is many db below this level, the most interesting range of transient behavior cannot be observed.

No further work is contemplated on this subject unless a suitable amplifier should become available.

F. NOISE GENERATION IN THE PRE-OSCILLATING MAGNETRON

Staff: V. Mayper

Since the last report, all effort has gone into the construction of a QK61 magnetron with insulated end caps, suitable for determining the relationship between noise generated and the current actually collected by the anode. This is intended to help resolve the unusual situation reported last time, that is, an apparent exponential rise of noise power with observed anode current. Technical problems of tube assembly have not yet been overcome.

In addition, experimental data on magnetron cavity Q as a function of pre-oscillating plate voltage are being checked again.