BASIC STUDY OF THE RF HIGH POWER AMPLIFIER FOR THE RIKEN SSC (STUDY OF THE SCREEN BYPASS CAPACITOR FOR THE FINAL STAGE)

S. Kohara, T. Fujisawa and Y. Chiba
The Institute of Physical and Chemical Research

Abstract

Screen bypass capacitors of RCA 4648 tetrode are manufactured for trial ,which are to be used for the high power amplifiers of RIKEN SSC. The performances of capacitors are studied.

1. Introduction

The power amplifier of RIKEN SSC is required to supply the maximum RF power of 300 kW in a frequency range of 17 to 45 MHz. RCA 4648 tetrode is to be used as a grounded cathode amplifier. In Fig. 1, the schematic diagam of the amplifier is shown. The plate tuning circuit is a $\lambda/4$ type stub and tuned by changing the length of the stub. The grid tuning circuit is a λ type stub and tuned by a variable capacitor . In Fig. 2-A, the simplified circuit diagram of the amplifier is shown. The symbols $C_0 \sim C_4$ are the capacitances between electrodes of the tetrode and C_5 is the capacitance of the screen bypass. For the stable operation of the amplifier it is necessary to reduce the coupling between the plate and control grid as far as possible. One part of the coupling is caused by the direct interelectrode capacitance C_0. The other part is attributed to the finiteness of the screen bypass C_5. The latter effect can be replaced equivalently by an additional capacitance C_0^* to C_0 as shown in Fig. 2-B. We can see that the capacitance of screen bypass has to be as large as possible in order to reduce the coupling.

2. Screen Bypass Capactor Manufactured for Trial

In Fig. 3, the screen bypass capacitor manufactured for trial is shown. The insulator is made of 50 μm KAPTON film (prepared by Du Pont). The capacitance calculated is 0.2 μF. The one measured is 0.11 μF. This discrepancy must be due to poor flatness of the electrode of the capacitor. Therefore the KAPTON film coated by conductive silver paint was examined. The capacitance measured was 0.26 μF.

The 50 μm KAPTON film endured such high voltage as 5 kV DC for long time(30 hours) in a preliminary test.

3. Measurement

The capacitor was mounted on RCA 4648 tetrode without the plate and grid tuning circuits. The plate was excited by a signal generator and the voltages of screen and control grids induced from the plate were measured. In Fig. 4, the ratios of screen and control grid voltages to the plate voltage are shown as a function of a radiofrequency. The ratios, when the screen grid was grounded, are also shown. The flat frequency responses seen in Fig. 4, show these capacitors operate well in the frequency range. The values of C_0 and C_0^* for C_5=0.11 μF and 0.26 μF deduced from the ratios are 1.5, 0.2 and 0.5 pF,respectively. The value of C_0 measured is 2.5 times of the value presnted in the catalogue. The capacitance C_0^* for C_5=0.11 μF is one third of C_0. In stability consideration of the amplifier it is indispensable to take account of the coupling effect of this order of magnitude. The capacitance C_5 obtained is satisfactory.

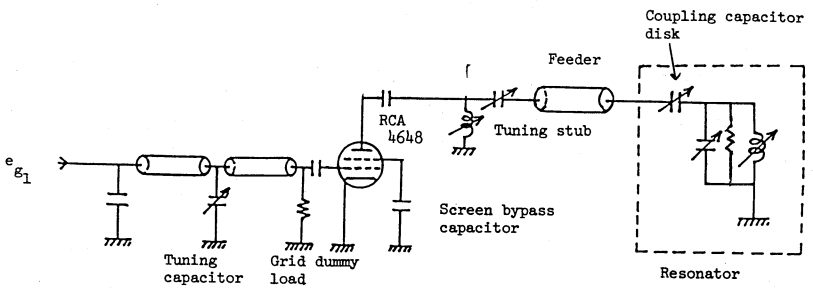

Fig. 1. Schematic diagram of the high power amplifier of RIKEN SSC.

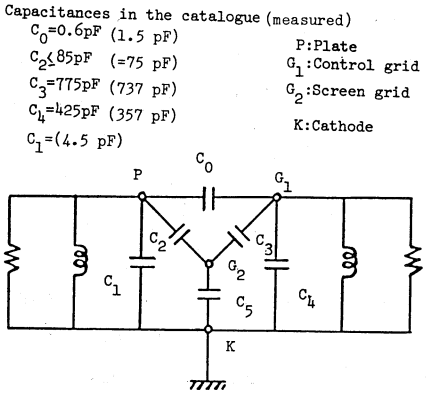

Fig. 2-A. Simplified circuit diagram of the amplifier.

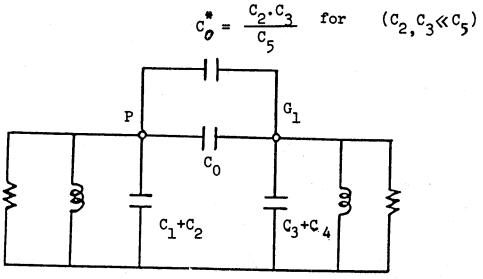

Fig. 2-B. Circuit transformed equivalently from the circuit in Fig. 2-A.

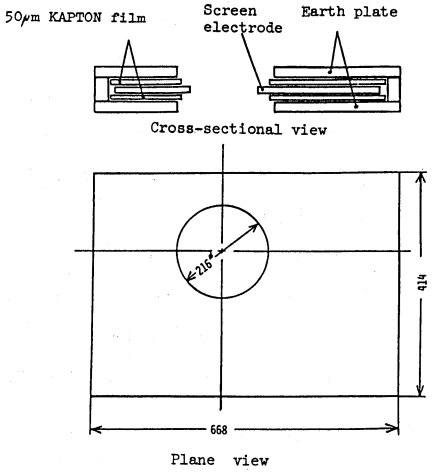

Fig. 3. View of the capacitor manufactured for trial.

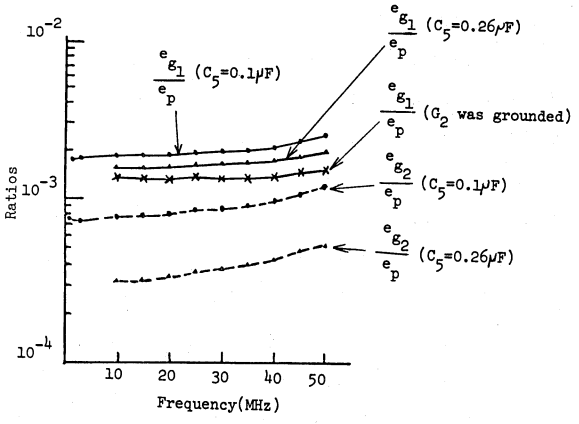

Fig. 4. Ratios of the screen and control grid voltages to the plate voltage.