RF SYSTEM FOR THE RCNP RING CYCLOTRON

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Abstract

A model study for a variable frequency H_{101} mode single gap RF cavity for the 1st ring of the new accelerator complex of RCNP has been done. Power amplifier, grid tuning system and coupling system between cavity and power amplifier are developed.

1. Introduction

Variable frequency H_{101} mode single gap RF civities with a tuning plate are being studied for the 1st ring and the 2nd ring of the cascade ring cyclotrons. A preliminary study of the RF cavities for the 1st and the 2nd ring was done with 1/10 scale models. A full-scale single gap cavity model of the 1st ring was made on the basis of the 1/10 scale model study[1),2)]. An RF amplifier using RCA-4648 has been made. The RF power amplifier can deliver 200 KW RF power. However the RF output power is limited to ∿10KW by the anode power supply (6 KV, 5A).

2. Input circuit

The tuning system made for input circuit of the RF power amplifier is shown in fig. 1. The input circuit consists of a quater wave-length coaxial line with a sliding short formed by an assembly of DC blocking condenser for grid bias, grid capacitance of the tube, 50 Ω terminating resistance and an assembly of bypath condenser for hot cathode terminal of the tube. The equivalent circuit of the tuning system is shown in fig. 2. The frequency range is 19 to 35 MHz. The voltage standing wave ratio is less than 1.02, and there is no spurious resonance below 100 MHz.

3. Output circuit

The schematic illustration of output circuit of the RF system is shown in fig. 3. The anode capacitance of the power tube is 85 PF, and self inductance of a coupling loop having a proper mutual inductance is micro farad. A coupling circuit is designed to cancel the effect of these reactions. Analysis of a coupling circuit has been done using the data obtained from the model study. An equivalent circuit of the output system is shown in fig. 4. The H_{101} mode of the cavity is expressed in lumped constants. The impedance matching of output circuit is performed by the variable capacitor (Cc) and the variable mutual inductance (Lm) of the coupling loop. Typical results of the analysis are given in table 1. An output coupling assembly to deliver 10 KW RF power has been made on the basis of the analysis, and RF power test (max ∿10KW) is in progress.

References

1) T. Saito, M. Inoue, A. Shimizu, H. Tamura and I. Miura, Proc. Ninth International Conference on Cyclotrons and Their Applications, Caen, les Editions de Physique (1981) p. 415.

2) T. Saito, M. Inoue, A. Shimizu, H. Tamura and I. Miura, RNCP Annual Report, (1981) p. 227.

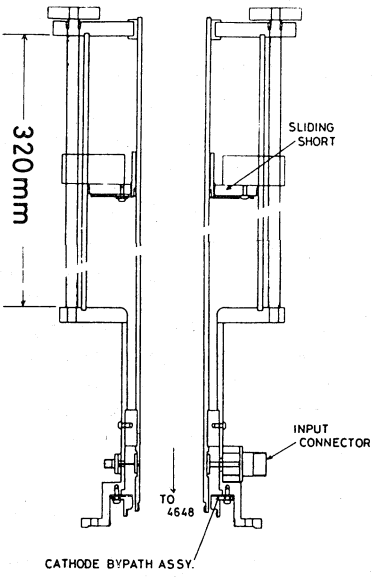

Fig. 1. Grid tuning system

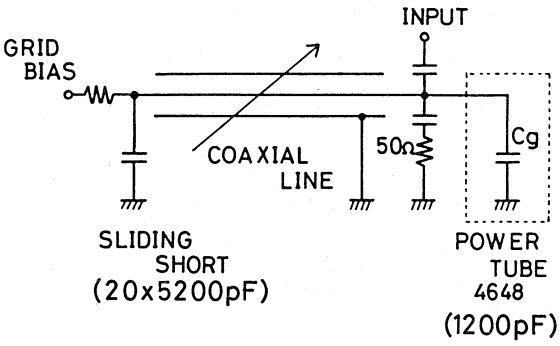

Fig. 2. Equivalent circuit of grid tuning system

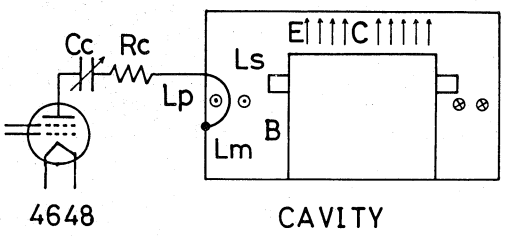

Fig. 3. Schematic illustration for output circuit of the RF system

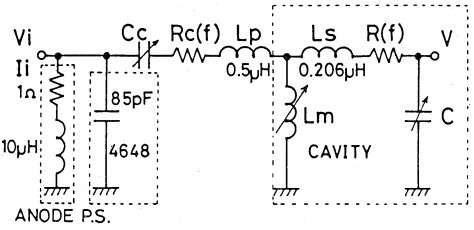

Fig. 4. Equivalent circuit for output circuit of the RF system

Table 1 Parameters of the output circuit

f(MHz)	20.0	25.0	32.0
Cc(pF)	127.29	81.532	49.802
Rc(Ω)	0.08	0.09	0.10
Lm(μH)	0.0061955	0.00523420	0.0045004
R(Ω)	0.00152	0.00170	0.00207
C(pF)	307.33513	196.68760	120.04084
Zin(=Vi/Ii)	400.0Ω,0.0°	400.0Ω,0.0°	400.0Ω,0.0°
V/Vi	33.1,0.0°	39.1,0.0°	45.3,0.0°
Q	17000	19000	20000