IV-1 MODIFICATION OF THE JAERI LINAC INJECTOR

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Abstract

To increase the linac current, the injector was modified such that the electron gun was located nearer the buncher and the drift distance of the prebuncher was made shorter. A prebuncher and its associated RF components were made together with beam focussing coils and a gate valve. The performance of the injector results in appreciable improvement of beam current and stability.

1. Introduction

The previously used injector of the JAERI linac is shown in Fig.1. In this arrangement the distance between the prebuncher and the buncher is 59 cm, and only a few kilowatts of RF power is required for the prebuncher.

There has been an earnest desire to improve the peak current of the linac, especially for neutron TOF experiments. It is difficult to improve largely the beam focussing in this arrangement, so that for the desire it is reasonable to locate the gun nearer the buncher and to make the drift distance of the prebuncher shorter, though a higher RF power is naturally required. If the drift distance is too large, the space charge of the beam itself may prevent proper bunching of the electrons.

Following this principle a new buncher and its associated RF components were designed and installed together with beam focusing coils and a gata valve. A beam monitor was also set. Details of the components and performance of the injector are given below.

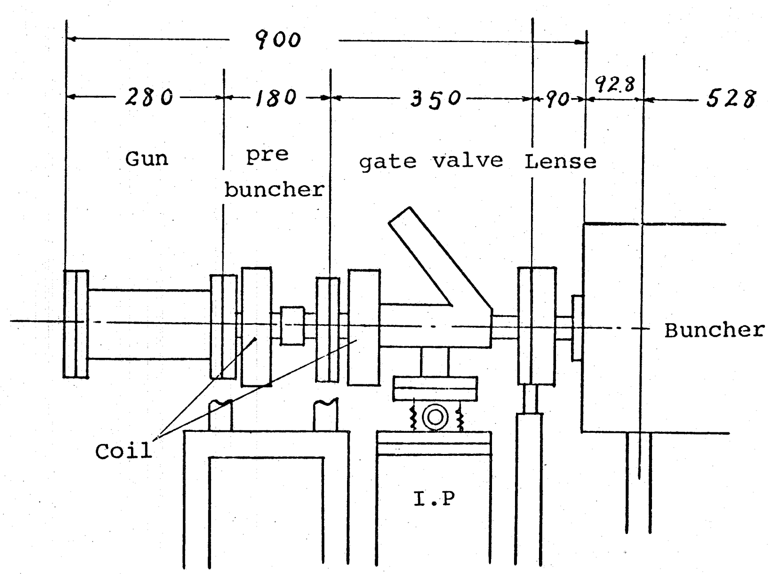

Fig. 1
Previous arrangement of injector

2. Arrangment of the injector

The new arrangement of components is shown in Fig.2. The drift distance of the prebuncher is now 13 cm, and the distance between the gun and the prebuncher is 24 cm. The parameters of the prebuncher are shown in Table 1. The resonance frequency can be adjusted with an attached bellows to the bottom of cavity in Fig.3. The resonance curve is shown in Fig.4, and the Q-value is relatively high as shown in the figure because of the copper making.

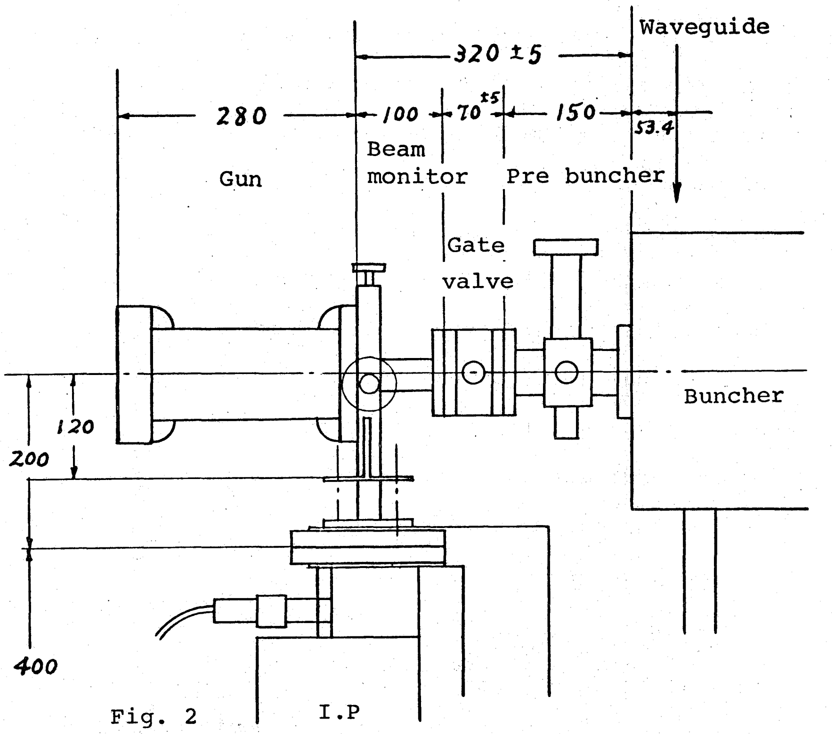

Fig. 2

Present arrangement of injector

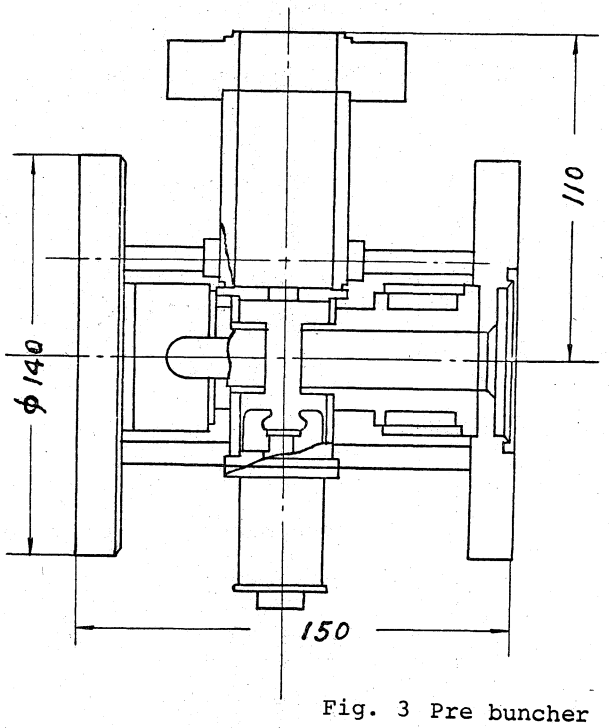

Fig. 3 Pre buncher

The previous gate valve is replaced by a new one which moves perpendicularly to the beam, thereby fascilitating the installation of focusing coils compared with the previous gate valve, which moves obliquely to the beam. The focussing coils were wound as many turns as possible to obtain a strong field. An iron yoke is used. At the tip of the gun a beam current monitor is installed along with inlet of the evacuating pump.

3. Performance of the injector

The perfomance test of the injector system alone was not made becuse of difficulty in preparing for measuring apparatus and of time economy, but instead, the system was connected to the linac, to which electron beams were injected, and accelerated beams were measured. The current of accelerated beam was measured with a current monitor located at the end of the fourth accelerating waveguide and the energy spectrum was then analyzed with an analyzer consisting of a defletion magnet, a slit and a beam catcher.

Fig. 5 (a) and 5 (b) show the variation of beam current and energy as a function of the RF power, and the RF phase of the prebuncher, respectively. The RF frequency is resonance, 2856.75 MHz, and the beam pulse width is 1.0 μseC. The full energy width (FWHM) of the beam is 9.3 %. The beam current of the ordinate is in relative scale, the maximum corresponding to the peak current of 220 mA.

Figs. 6 (a) and 6 (b) show the variation of beam current and energy with the variation of RF power and that of phase, respectively. The RF frequency is the same as in Figs 5 (a) and (b), but the beam

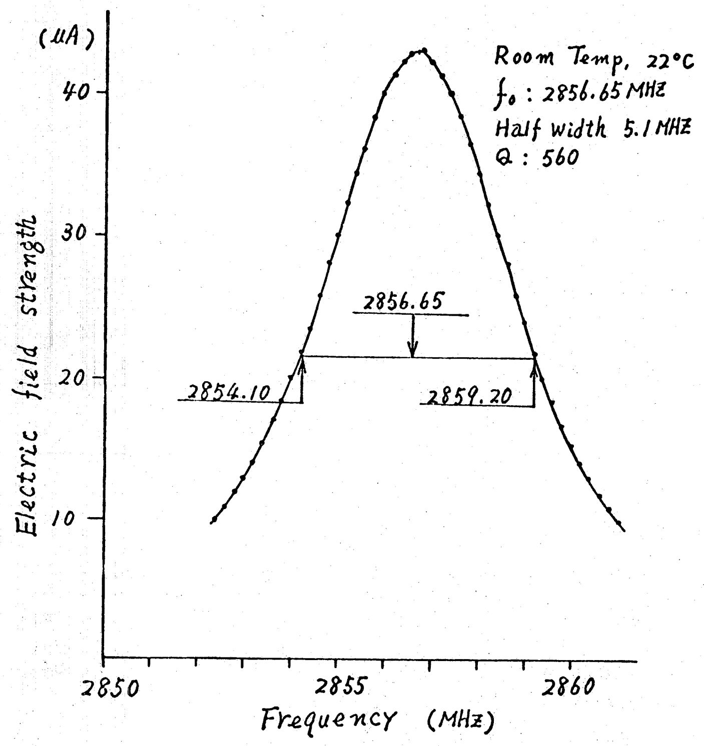

Fig. 4 Resonance curve of the prebuncher

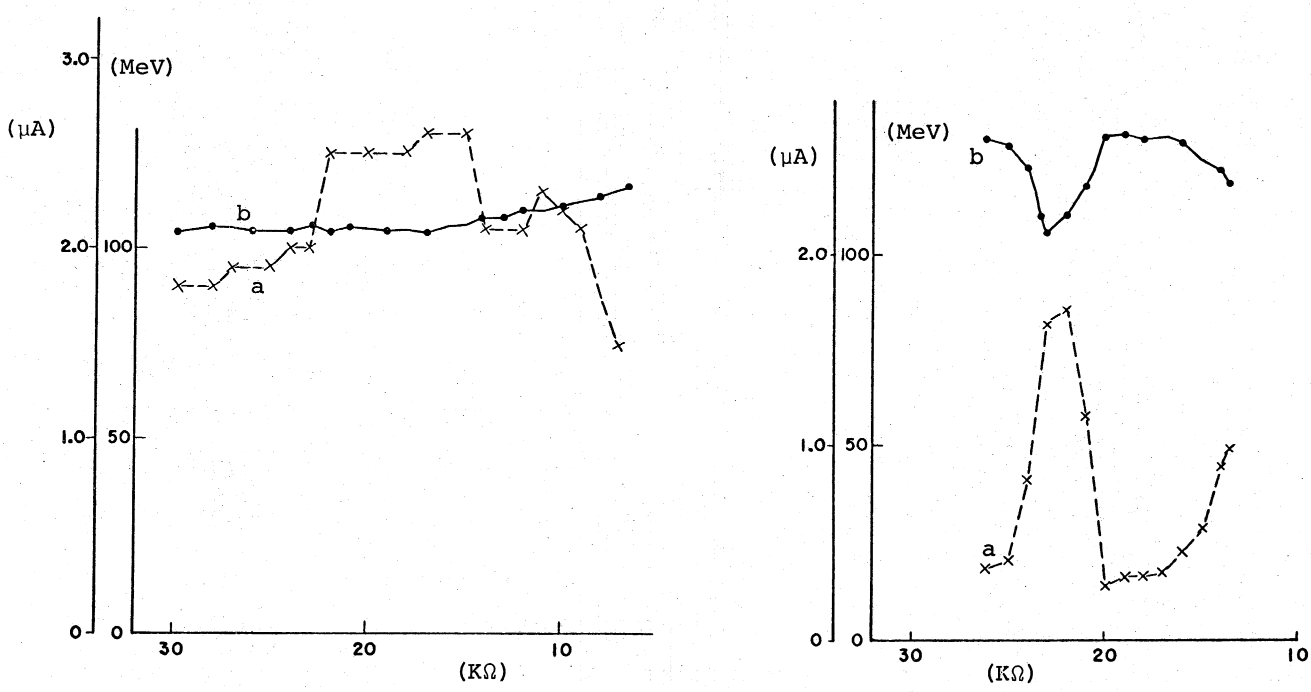

Fig. 5 (a) Beam current and energy vs RF power of prebuncher

(b) Beam current and energy vs RF phase of prebuncher pulse width is 30 nanosec and the peak current is 1.4A. The energy spread of the beam (FWHM) is 19 %. When the peak current decreases down to 480 mA, the energy spread also decreases to 7 %, which suggests space charge effect maybe significant in the prebuncher and buncher where the beam energy is low.

Compared with the accelerated beams obtained with the previously used injector, the masimum peak current obtained on the target in the present linac is 3A, compared with the previous value of 1.9 A at the pulse width of 30 nsec. Previously the beam current depended critically on the adjustment of beam transport in the injector, however this seems much improved in the present injector.

Fig. 6

(a) Beam current and energy vs RF power of prebuncher

(b) Beam current and energy vs RF phase of prebuncher