THE INJECTION SYSTEM FOR THE ETL STORAGE RING

S.Sugiyama, T.Noguchi, T.Yamazaki,
T.Mikado, M.Chiwaki and T.Tomimasu

Electrotechnical Laboratory

Abstract

The injection system has been constructed to deliver the electron beam from the linac to the storage ring and inject electrons to the ring. The main elements of the system are a pulsed deflection system, a beam transport system and a septum magnet. The transported beam intensity is approximatly 1/3 of the beam intensity from the linac.

1. Introduction

Fig. 1 shows the schematic illustration of the electron injection system from the linac to the storage ring. In the figure, PC refers to a 5° pulsed deflection system, DSB-1 2 dipole magnets (bending angle 31°), QD-1~5 quadrupole doublets, STC-1 vertical steering coil, STC-2 and STC-3 horizontal and vertical steering coils, STM-1 and STM-2 vertical and horizontal small sweep magnets, BPM-1~3 beam position monitors, and a septum magnet.

2. 5° Pulsed Deflection System

The pulsed deflection system is designed to deflect electrons of momentum up to 400 MeV/c by an angle of 5.5°. The coil pair consists of two saddle shaped coils with a length of 36 cm and a width of 12 cm and is set with a ceramic beam duct compuctly. The pulsed coil is wound of copper braid insulated with heat-treated glass fiber tapes and has 20 turns/coil. It is air-cooled by a fun. The pair is excited by a silicon-controlled-rectifier pulser which produces a current in a half-sinusoidal wave of 1 kH_Z at a repetion rate of 50/32 pulses/sec. The magnetic field strength to deflect 306 MeV electrons by an angle of 5.5° is 2710 gauss and the corresponding pulse current is 1140 A. This value is larger than the estimated one by 16 % from the experiment in the case of dc current exciting. It is due to the eddy current loss in the coil. The drift of the driving pulse current is detected by a searching coil which picks up the magnetic flux produced by the pulsed coil pair. The stability of a peak current of 1000 A is kept within 0.5 %. Since the coil pair is excited by pulse current, the beam duct installed between the saddle shaped coils should have a high electrical resistance to keep eddy-current loss low and should have a high mechanical strength. The ceramic vacuum duct used here have a length of 40 cm, an oval diameter of 7.6 cm and a wall thickness of 0.7 cm and its inside is coated with a low resistivity titanium compound.

3. Beam Transport System

To find out the optimum operating parameters of coils and magnets, beam position monitors observing optical transition radiation are effectively used. The spot size and the position of electron beams are measured by observing transition radiation from the 0.5 mm thick Al foil on which horizontal and vertical scales are marked. The deflection angle of DSB is 31° and the bending radius is 2 m. The maximum radial size of the transported beam through the beam line is limited to 43 mm, which is within the diameter of beam duct, 72 mm. The three steering coils and two small sweep magnets are used for fine adjustment of the beam position and direction. On the foil of the beam monitor at the position 65 cm upstream from the inlet of the ring, beam intensity is approxmatly 20 n coulomb 1 pulse (1 μsec) and beam size is 5 mm (horizontal) by 3 mm, which is enough small when compared to the size (15 mm x 8 mm) of the inlet of the septum magnet. Injected electrons passing through the small bending gap of the septum magnet are monitored using the ETL type quantameter (Q-II). The stored current in the ring increases up to 150 mA at 300 MeV at present. Fig. 2 shows the increase of the stored current since the first beam storage on October 7 1981. The maxmum increment of the stored current is achieved to be 15 mA/min.

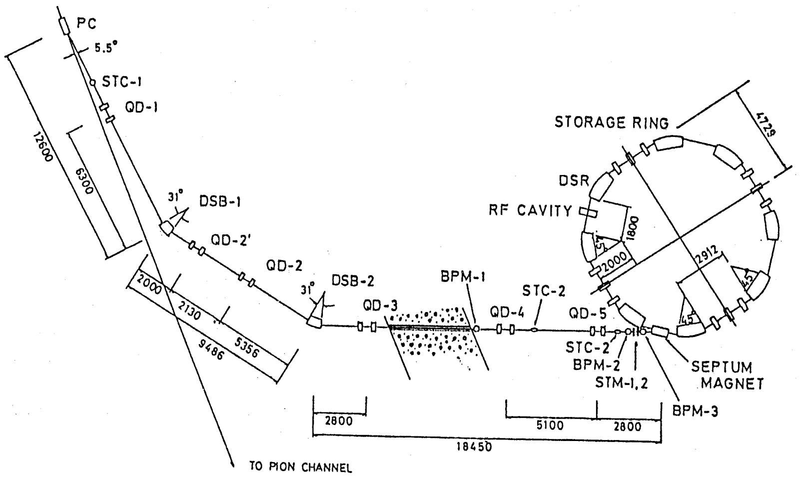

Fig.1 The schematic illustration of the injection system

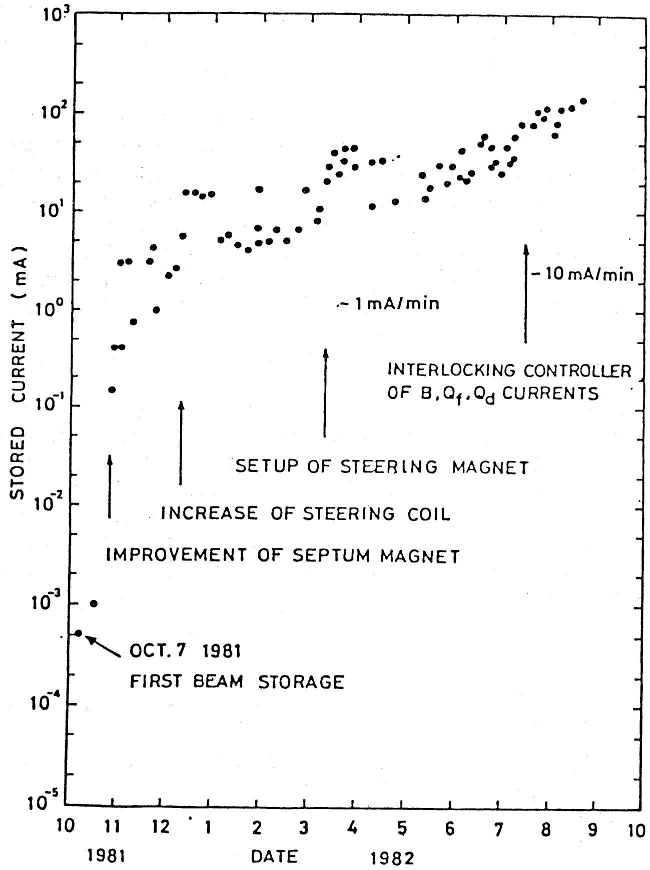

Fig.2 The increment of the stored current since the first storage