

Development of the Kicker Magnet for Beam Extraction

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1. Introduction

There are five kicker magnets in the Spring-8 synchrotron, two for injection and three for extraction. They are required to have a fast rise- and fall-time, as the next bunched beam is not affected. The exiting duration of the kicker magnets must be shorter than 320 nsec. One kicker magnet for the beam extraction have been made, and the field-measurement and a few improvements have been progressing.

2. Magnet

Each kicker magnet for beam extraction have a transmission-line structure of 17 cells with C-shaped ferrite-cores and electrodes. Thickness of the ferrite core and electrodes are 18.5 mm and 4 mm, respectively. The core and the electrodes are stacked alternately. The cores are placed between the electrodes and they also increase the capacitance. These are surrounded by a single-turn coil. The kicker magnet is placed in the vacuum chamber and two feedthroughs are located on the both ends of the magnet. To minimize the inductance of the feedthroughs, the length of the feedthroughs are to be as short as possible. To measure the waveform of the current at the inlet and the outlet of the kicker, current transformers are located on the feedthroughs. In order to decrease the capacitance between the kicker magnet and the vacuum chamber, the kicker magnet was covered with the aluminium plate. Figure 1 shows a cross-sectional view of the kicker magnet for the beam extraction.

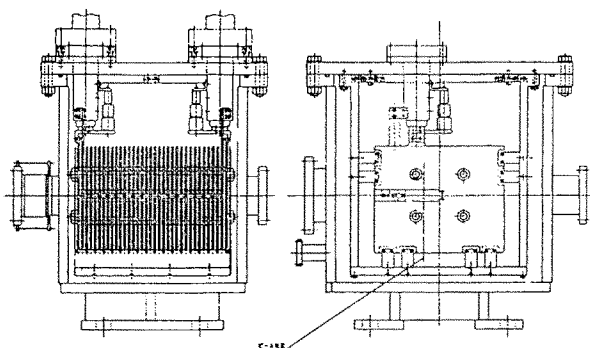


Fig. 1. The cross sectional view of the kicker magnet for the beam extraction

3. Power supply

The power supply consists of the DC high-voltage power supply, the PFN(pulse-forming-network), the thyatron, the switch for two pulse-modes and the termination. Figure 2 shows the equivalent circuit diagram of the kicker magnet and the power supply. The power supply provides the peak current of 1142 A with the shape of trapezoid, the 60-nsec flat-top for the short pulse and the 1320-nsec flat-top for the long pulse. The length of charging cables are 15.5 m for the short pulse and 115 m for the long pulse. The kicker magnet and the power supply are connected with the transmission cable. To avoid the reflected current into the flat-top of the short pulse, the cable length must be more than 25 m. On the other hand in order to minimize the loss in the cable, the length of the cable should be as short as possible. Thus, the length of the cable was decided to be 33 m.

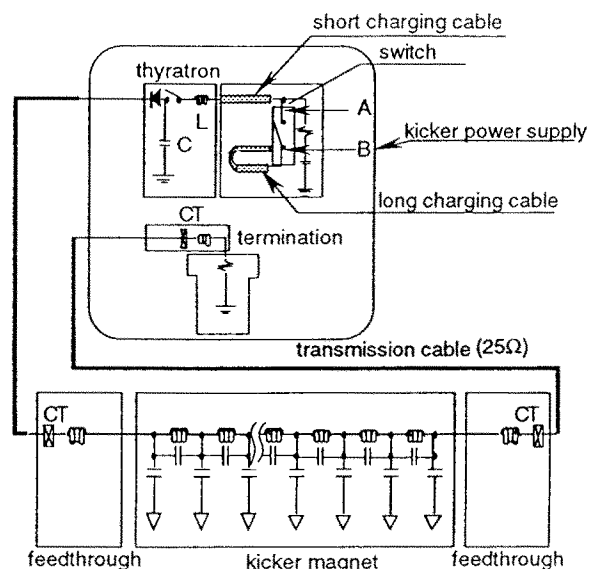


Fig. 2. The equivalent circuit diagram of the kicker magnet and the power supply

4. Measurements

The waveform of the current was measured by two current transformers. The magnetic field-distribution and the waveform of the magnetic field were measured by the short search-coil of which the diameter is 11.7 mm and the effective area is $1.08 \times 10^{-4} \text{ mm}^2$. The integrated magnetic field along the beam axis was measured by the long search-coil of which the width is 3.3 mm and the length is 600 mm. The terminal of the

search-coil is connected with the 1000:1 high-voltage probe and the digital storage oscilloscope. The measurement of the waveform of the current showed that the kicker had no reflection. The distribution and the waveform of the magnetic field were measured. The rise time of the waveform was less than 100 nsec, and the flatness at the flat-top was less than 4 %. The integrated magnetic field along the beam axis was measured, it was confirmed that the kicker had the uniformity of the field on the median plane. All results of the measurement were satisfied with the specification.