DESIGN AND OPERATIONAL PERFORMANCE OF SUPERCONDUCTING COIL FOR SSC SECTOR MAGNET

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Abstract

A study of a superconducting coil for Separated-Sector Cyclotron was made. The superconducting coil of 1/4 scale 50° sector model magnet was designed and fabricated. The maximum field of the model magnet is 17.5 KG. The design and operating performance are presented below.

Design of superconducting coil

The coil was designed for 1/4 scale model sector magnets planned by IPCR. Some relevant design parameters are listed as follows.

Superconducting coil parameters

Max. excitation	:	32,500 AT
Conductor	:	NbTi, 1.6x2.5 mm
Copper ratio	:	4:1
Operating max. current	:	650 A
Critical Current	:	1,000 A (AT 5T)
Number of turns	:	50
Max. current density	:	162.5 A/mm^2
Weight	:	30 Kg/coil

Refrigeration for the coil is based on direct immersion cooling in a liquid helium bath.

Figs.1 & 2 show the outline and the cross-section of the cryostat. The external dimensions of the cryostat are the same as the normal copper coil already made, being able to exchange. The welded helium can is completely enclosed by a copper heat radiation shield wrapped with 16 layers of super insulation. The shield is housed in the stainless steel cryostat vacuum vessel. The coil is suspended by 4 pairs of 10 mm diameter FRP rods.

In order to assure the stability of the superconducting coil, the magnetic leakage flux through the coil was computed by the TRIM code. Maximum flux density on the surface of the coil was 4 KG.

Operational performance

The coil was excited for testing without the iron core. Fig.3 shows the fully assembled superconducting coil. The cryostat of the superconducting coil is attached with the LHe vessel to supply electric power and LHe. The coil achieved up to max. current (I=650 A) without any quenches. The coil was cooled from room temperature to LN_2 temperature in 40 min. It took another 110 min to cool the coil up to 4.2 K. During normal operation (I=650 A), thermal loss was 4.7 watts.

The influence of the flux upon the excited coil

Electromotive forces are induced on the coil by leakage flux from the poles. This forces are vertical, lateral and twisting. As the lateral and twisting forces can be decreased to an almost negligible degree by means of adjusting the position of the coil, the coil is designed mainly to support the vertical force.

The section of the full-scaled coil are almost the same size as that of the 1/4 scale model coil. So, relatively the distance between coil supports decreases, and the thermal losses through the supports increase.

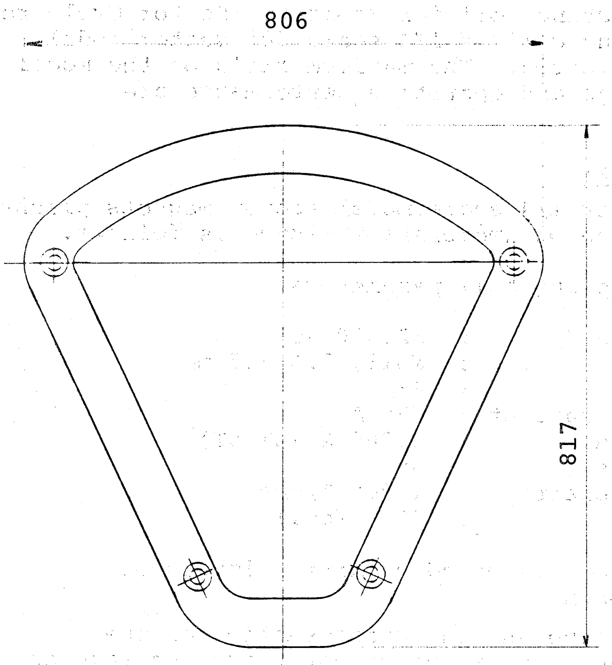

Fig.1 The outline of the cryostat

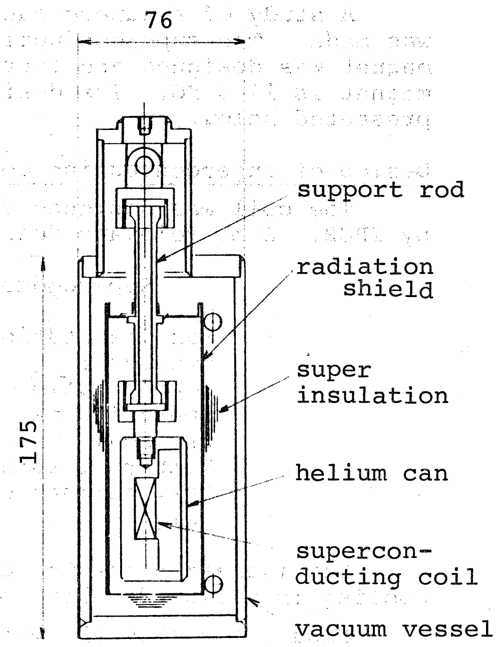

Fig.2 The cross-section of the cryostat

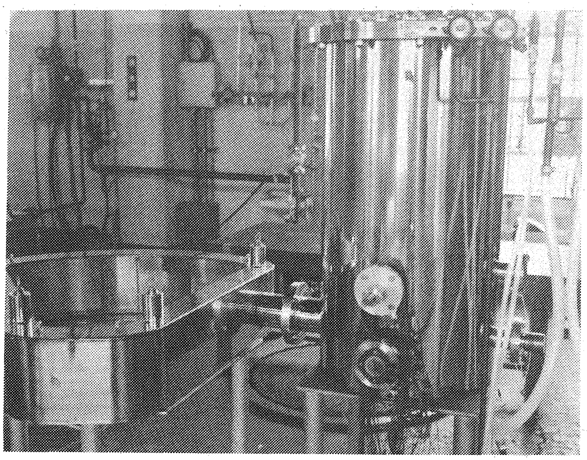

Fig.3 The fully assembled superconducting coil