ALL ALUMINUM ALLOY VACUUM SYSTEM FOR TRISTAN MAIN RING

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Design of all aluminum alloy vacuum system for 8 ∿ 30 GeV electron-positron storage accelerator is presented.

New all aluminum alloy vacuum system of accumulation ring(2.5 ∿ 8 GeV electron-positron) has been constructing. Suitable aluminum alloy vacuum chamber and vacuum components have been developed. The evaluation of these components were made. The performances of these components are excellent. Assembly of the vacuum system of the accumulation ring will start March 1983.

The vacuum system and its components are basically the same as one of the accumulation ring. Much efforts were paid to minimize the free space between the bending and the quadrupole magnets. Direct jointing of the beam pipe without flange fitting were accomplished by means of automatic welder and elliptical bellows. [Fig. 1] [Fig. 2] Cooling channel and feeder are also welded onto the beam pipe directly without fittings. Correction magnets such as a sextupole and a dipole magnet could be installed onto the jointing parts. Maximum line power density of the synchrotron radiation along the beam pipe is 1.3 kW/m for 30 GeV 7mA x 7 mA electron-positron beams. A small aluminum alloy block which is cooled by water, formed on the inside wall of the beam pipe protects the aluminum alloy bellows and the ceramic chamber for kicker magnet against intense and hard synchrotron radiation. [Fig. 3] All beam pipes are covered with lead of 10 mm in thickness to shield strong X-ray radiation.

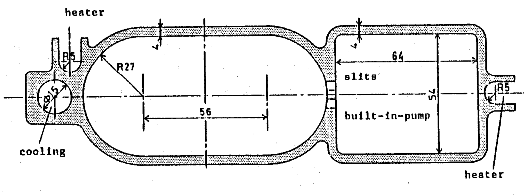


Fig. 1 Extruded aluminum alloy vacuum chamber of the bending magnet.

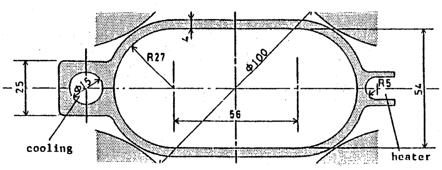


Fig.2 Extruded aluminum alloy vacuum chamber of the quadrupole magnet.

Distributed sputter ion pump, specially designed for low magnetic field of 0.8 kG works as a main pump. Lumped sputter ion pump of 30 ℓ/s pumping speed installed in each beam pipe of bending magnets to sustain high vacuum while not operated of distributed sputter ion pump. Bulk getter pump helps these ion pumps. [Fig. 4] A all metal gate valve is inserted in every three normal cells. It has dual flat face seals with differntial pumping and the elliptical aperture for beam impedance matching. The roughing pump is a combination of a 50 ℓ/s turbomolecular pump and a 250 ℓ/m mechanical pump. The semi-automatic isolation angle valve is installed between the roughing pump and the ultra-high vacuum side. The sputter ion pump of 500 ℓ/s pumping speed works as a main pump for rf cavity.

The operating pressure of these ion pumps is in the range of $10^{-6} \sim 10^{-10}$ torr. The discharge current at the order of 10^{-6} torr is the order of mA. We use the 5 kV and 5 mA (20 mA for 500 ℓ/s ion pump of rf cavity) dc-dc converter type high voltage power supply. Two power units are installed in 2U type NIM-module(5 mA). The insulated cathode of the distributed sputter ion pump makes it possible to measure the Penning discharge current at pressure as low as 10^{-9} torr, and may open, using the built-in-pump as an ultra-high vacuum gauge. Invert-magnetron type cold cathode gauge measures in the range of $10^{-3} \sim 10^{-9}$ torr. These ion pumps and gauges are controlled by a computer with interface of the CAMAC system.

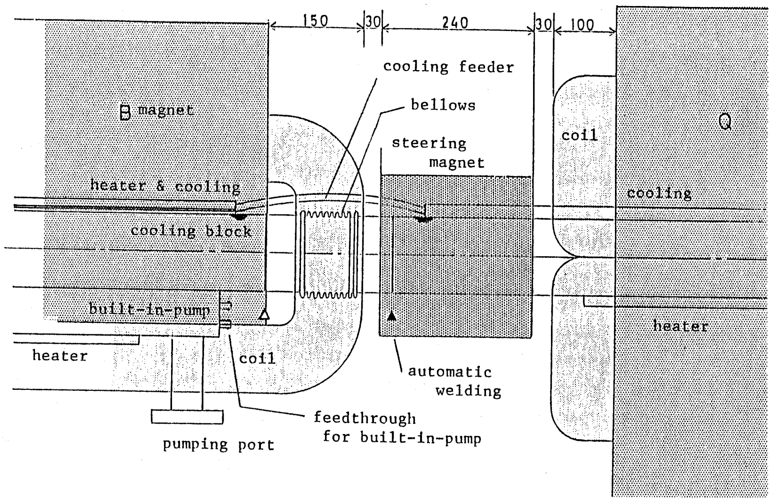
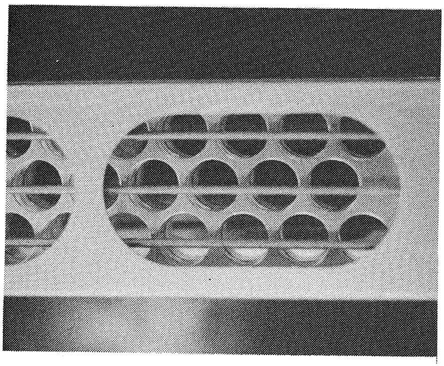


Fig. 3 Typical vacuum system for free space between the bending magnet and the quadrupole magnet.



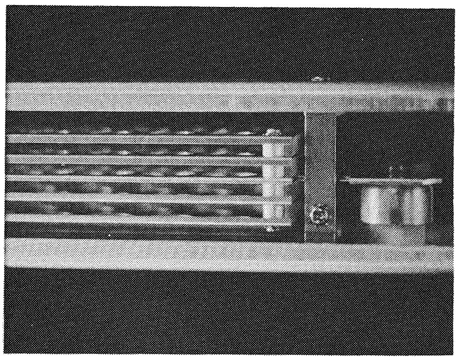


Fig. 4 Distributed sputter ion pump works in low magnetic field (0.8 kG). Pump element consists of the five layers perforated stacked aluminum anode cells and the isolated titanium filaments.

The vacuum system could satisfy such conditions as high performance, high reliability, simplicity, high space factor of free space, impedance matching and low cost.