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Both the fast and slow extraction of proton beams accelerated in the KEK main ring are performed by an electrostatic septum (ES) system. The ES in each system has the following characteristics:

Length: 1 m  $\times$  3  
Septum: 0.05 mm $\phi$  75 % tungsten - 25 % rhenium wires at a spacing of 1.25 mm  
Working field:  $\geq$ 60 kV/cm for a gap of 2 cm,

and has been tested its performance with 8 GeV proton beams.

One of the essential points in developing electrostatic separators is that the septum should be vanishingly thin and perfectly flat. Moreover, it must remain so in the presence of electric stress and local heating which is caused by sparks or beams hitting on it. Usually the septum is composed of parallel wires or a thin foil stretched on a frame. In the initial designing of the KEK-ES, it was considered to be easier to build and maintain a perfect plane with parallel wires than with a foil, because it is difficult to obtain an uniform tension near the edges of a stretched foil. The frame supporting the wires has a C shape machined from a single piece of an aluminum block. The aperture of the frame is 55 mm  $\times$  135 mm which is large enough for the circulating beam. The wire is wound with a tension of 200 g along the guiding grooves cut on the surface of the frame. The groove is triangular with an opening of 0.42 mm and angle of 40°. At the same time, the wire is swaged by squeezing the groove with the knife edge of a tube cutter. The flatness of the wire plane is held within  $\pm 0.01$  mm over a length of 1 m. The cathode is machined from a single piece of a 99 % titanium plate. Each of the three cathodes is supported on the chamber wall with a pair of glass bushings and is supplied the negative high tension through another alumina bushing by a common HV generator. Each cathode has a 1 M $\Omega$  protection resistor and a 20  $\Omega$  damping resistor in series. The stainless steel vacuum chamber has a dimension of 3080 $\phi$   $\times$  450w  $\times$  452d mm<sup>3</sup> with a demountable ceiling flange.

The conditioning of the ES was carried out prior to the installation in the main ring. In a few days 140 kV was attained with a spark rate of once per 15 minutes and at 120 kV no break down due to spark was occurred for 100 hours. After installation in the main ring, the ES was operated for one month without proton beams. When there are circulating beams, the dark currents at

a 3 m section is typically 110  $\mu$ A and sparking occurs once per 10 minutes on average. The vacuum is maintained below  $1 \times 10^{-6}$  Torr. Extraction of 8 GeV beams with  $10^{12}$  ppp has been done for thirty days with an efficiency of 90 %, and yet no wires are broken.

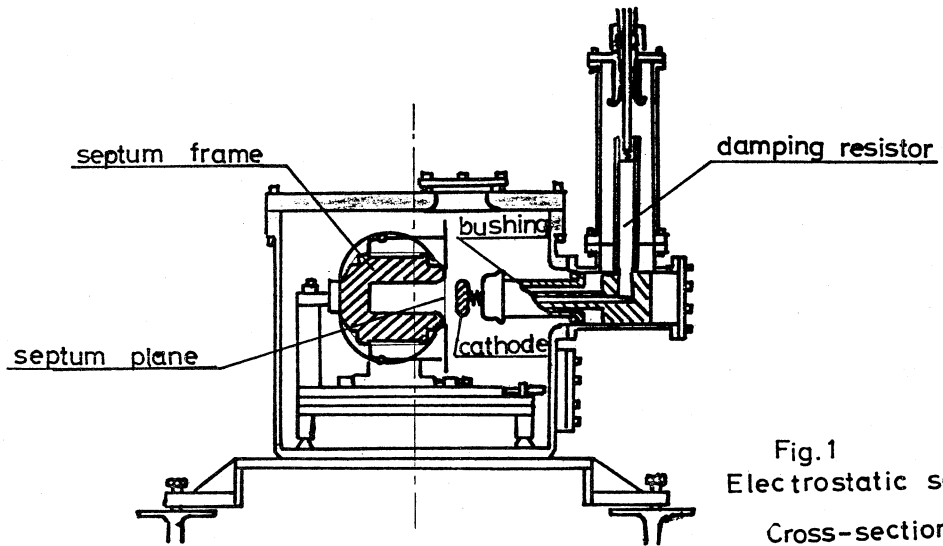


Fig. 1  
Electrostatic septum  
Cross-section

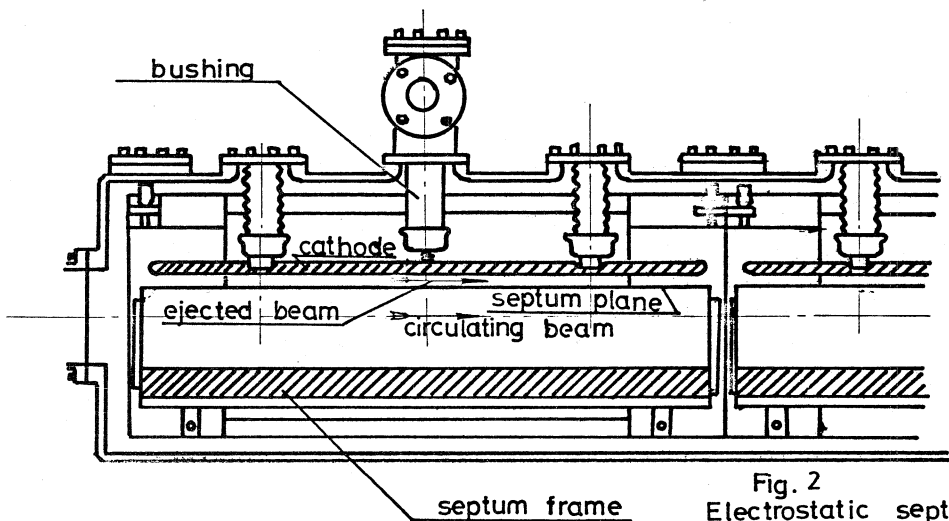


Fig. 2  
Electrostatic septum  
Plane view