

### NIMROD INJECTOR: BEAM MONITORING SYSTEM

The proton beam current is measured at various points along the Injector to monitor the performance of the individual parts of the machine, e.g. the linac, focusing magnets etc. Also, measurements of the fraction of the beam current transmitted by variable apertures along the beam path, are essential for optimising the beam which is injected into the synchrotron. The current measurements could be performed using the classical collecting method (Faraday cup) but this has the disadvantage of destroying the beam. The use of suitably designed current transformers allows non-destructive current measurements to be made.

Basically the system consists of a series of toroidal current transformers with the proton beam itself acting as a single 'turn' primary. When a beam current pulse passes through the toroid it induces a small e.m.f. in the secondary winding. This signal is amplified and observed on an oscilloscope.

The toroid also has a single turn winding, through which a current pulse of known amplitude (calibration pulse) is passed a few tens of microseconds after the beam pulse. The amplitude of the beam pulse signal is compared on the oscilloscope with that of the calibration pulse. This gives a measurement of the beam current which is independent of the overall gain or linearity of the system.

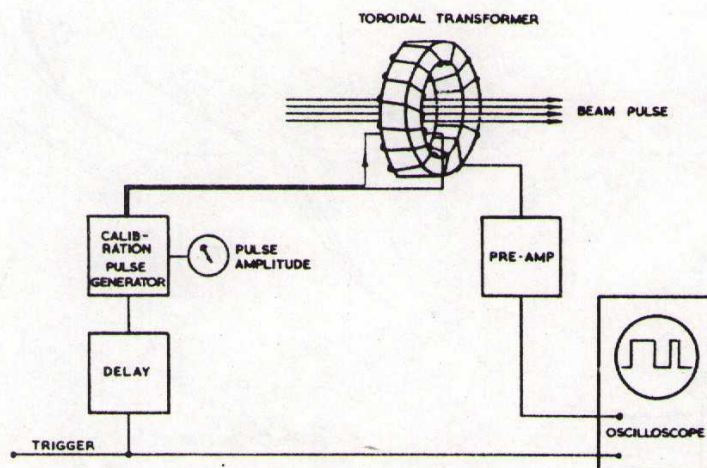


FIGURE 1. RUDIMENTARY BEAM MONITORING SYSTEM



A pre-amplifier is situated near to each toroid and the monitoring point is selected at a four-channel, twelve-way, remotely-controlled selector unit.

Two toroids, wound on a mumetal core, are employed at each monitoring point. One type measures beam pulses between  $10\ \mu\text{sec.}$  and  $2.5\ \text{msec.}$  in duration and the other, smaller type measures pulses between  $300\ \text{nsec.}$  and  $20\ \mu\text{sec.}$  long. They are contained within a screening mount which has two permanent ring magnets, magnetised across a diameter. These serve to stop low-velocity electrons passing through the toroids.

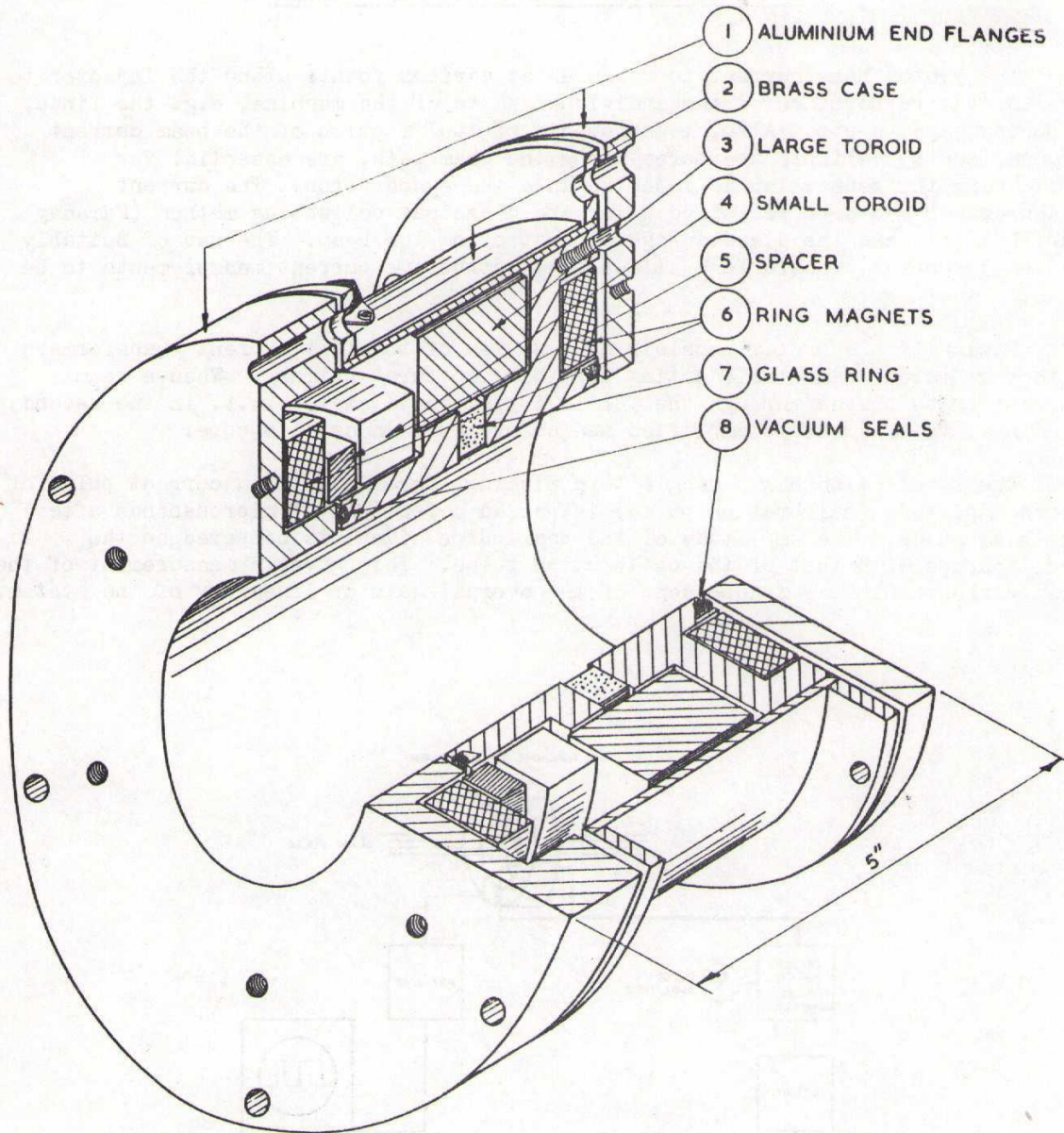


FIGURE 2. SCREENING MOUNT FOR TOROIDS

Exhibit

The working model of the beam monitoring system is very similar to the rudimentary system shown above. The beams is simulated by a current pulse (from an additional generator) fed along a wire passing through a toroid. The units used in the exhibit are the operational spares for the beam monitoring system. It can be seen that measurement of the beam current pulse is simple and rapid.