VACUUM SYSTEM OF THE TOKAMAK NOVILLO

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Abstract

A toroidal vacuum chamber of 28 access ports was constructed from fours stainless steel 316L elbows joined together with dielectric seals to provide voltage break in the toroidal direction. All vacuum seals were viton O-rings. A 500 l/s turbomolecular pump provide a base pressure of $4x10^{-8}$ mbar with light backing (∿60°C).

In the regime of cleaning discharge the toroidal chamber is filled with H_2 to a pressure of 0.2 + 0.4 mbar. The ohmic heating coils are pulsed with a AF oscilator (10 kW, 17.5 kHz) for 60-80 msec, at a repetition rate of about 2 Hz. A toroidal magnetic field of roughly 600 G is added to generate the cleaning discharge.

According to a residual gas analyzer installed in the system, 80% of the base pressure was given by water; the other components were hydrogen and mon- and dioxides of carbon.

1.- Introduction.

The vacuum system on Novillo Tokamak[1] is of course designed to be physically compatible with the toroidal field coil. The toroidal chamber is supported by eight beds located at its lower portions. To avoid mechanical coupling between the turbo-molecular pump and the chamber, a stainless steel bellow has been installed between them. There are a total of 28 ports which represent to wide accessibility for diagnostics, for instance it posesses 8 ports for purposes of microwave, 4 ports for spectroscopy, 2 ports for Thomson scattering at the future. Phot. 1.

2.- Vacuum System

The discharge vessel is made out of four 316/L stainless steel 90° bends of 3.2 mm wall thickness. Interconnection is accomplished by means of several flanges containning Viton O-rings to provide an adequate voltage breaks. The base vacuum pressure was reached using a turbomolecular pump (Balzers, TPU/500) of 500 l/s, it was $4x10^{-8}$ mbar in a two week operation with a light backing (∿60°C) We expect to improve it with intensive evacuation and discharge cleaning; the pressure measurement was carried out by Pirani and ionization gauges, located at various points on the discharge vessel.

The working gas (hydrogen) is injected by an automatic pressure controller APC-110 and a precision leak valve PV-10.

3.- Residual Gas Analysis.

The obtained base pressure spectrum showed that (water vapour) reached about 80% of the total pressure. The remaining 20% was composed by Hydrogen, Oxigen and non- and dioxides of carbon. Such a high water content was found to be due to the fact that viton seals were not treated for working under vacuum conditions, owing to the obsence of the necessary equipment. In this case, a vacuum baking before mounting is recommended for dimnishing the water absorbed by the viton[2].

The Fig. 1 shows a spectrum analogous to that obtained for the base pressure. The peaks with numbers 20 and 40 correspond to argon, the presence of which is explained by the fact that the turbomolecular pump was previously vented with argon.

This spectrometer also was used as a leak detector. A spectrum typical for a leak is showed in Fig. 2, where the partial pressures of the components 28, 14, 32 and 16 correspond to the atmospheric air partial pressures.

The Fig. 3 shows the case of a leak detection using argon as a test gas. Before introducing the test gas, a spectrum analogous to Fig. 2 is obtained. When the vacuum chamber is filled with argon the peaks 14, 16, 28 and 32 diminish and other peaks with numbers 20 and 40 appear, from which it may be concluded the presence of a lake.

4.- Discharge Cleaning

The most effective technique for vacuum surface conditioning is know as discharge cleaning and its efficiency has been documented on other devices[3]. In general, a discharge cleaning plasma consist of a low temperature gas discharge which is sustained within the vacuum chamber for several hours per day in order to bake out the vacuum surfaces from the inside of the chamber.

There are several techniques used to generate such a discharge but on Novillo Tokamak We employ the 17.5KHz R.F. fields provide by the oscilator in a pulser mode to drive about 10 KW of power into the discharge. The power deposition is enhanced by providing a low ($\sim$600 G) toroidal magnetic field to improve confinement of the discharge cleaning plasma.

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2.- H. Frederick Dylla. J. Vac. Sci. Technol., Vol. 15, No. 2, March/April 1978.

3.- L. Oren and R.J. Taylor, Nucl. Fusion 17 (1977) 1143.

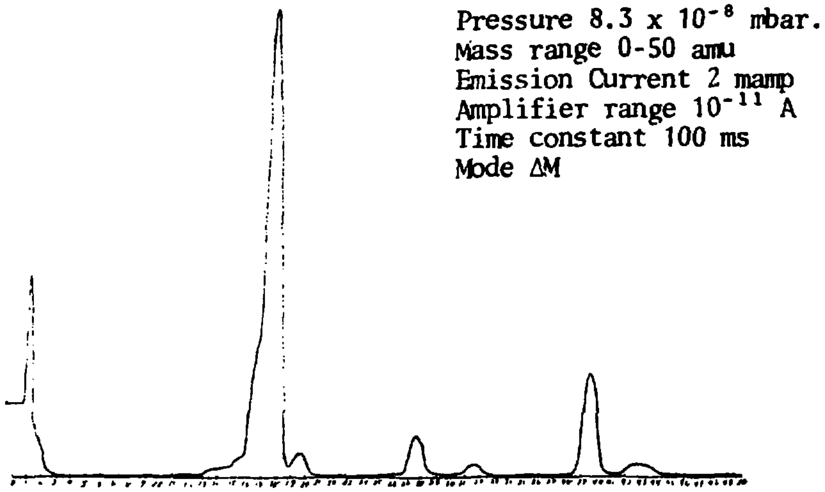

Fig. 1. Residual Gas Novillo Tokamak

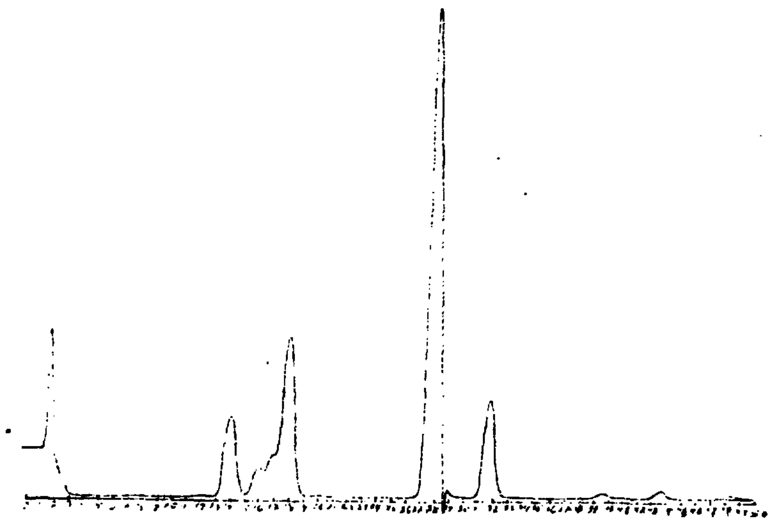

Fig. 2. Spectrum Typical for a leak.

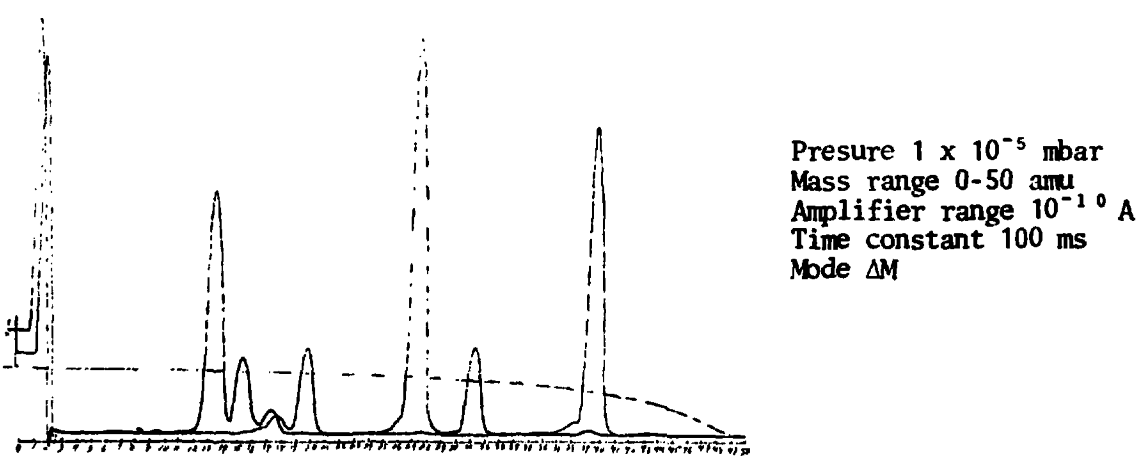

Fig. 3. Leak detection using Argon as a test gas.

Photography 1. The vacuum system of the Novillo Tokamak