7. Study on the Philips Gauge

Yoshiaki Uemura, Masakatsu Sakisaka, Yoshihisa Ōno and *Shôichi Miyashiro*

(K. Kimura Laboratory)

A simple philips type ionization vacuum gauge instrument convenient for the measurement of the low pressure was constructed.

A circuit diagram and the dimension of the discharge tube are similar with that shown in the "High Vacuum Technique" by Dushman.

In the discharge tube, the electrodes were made of Aluminium, the anode was a rectanglar (30×50 m.m.) frame of 7 m.m. in width, and the cathodes of two rectanglar plates (14×18 m.m.) were 28 m.m. apart. 240 gauss Magnetic field was applied with a permanent magnet.

As the A.C. high voltage supply for discharge tube, a 2800 V transformer with adequate stabilizer in the primary circuit was used.

Using this Philips gauge, we have been able to measure the low pressure from 10^{-3} m.m.Hg to 10^{-6} m.m.Hg by exchanging the shunt resistance of D.C. microammeter. For example, when we used 500 KΩ as the current limit resistance, the ion currents were 1.8 mA in 10^{-3} m.m.Hg, and 40μA in 7×10^{-6} m.m.Hg for residual gas.

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8. Studies on the Evacuation of the Large Pumping System

Yoshiaki Uemura, Masakatsu Sakisaka, Yoshihisa Ōno and *Shôichi Miyashiro*

(K. Kimura Laboratory)

Four atomic disintegration experiments, it is necessary to know the pumping speed of the diffusion pumps for light gases and design the evacuation pipes and the ion source for proper operations. For this purpose many gas leak methods have been practised with insufficient results. But we divised a new gas leak apparatus by which a gas leakage was adjusted continuously and automatically according to the following equation.

$$q=G\ \exp\ (-Gt/V)$$

Where q is the leak quantity per second, G the conductance of a small leak, V the volume of gas reservoir and t the time.

By this automatic method the pumping speed for hydrogen and duterium was easily known in the range of $8\times10^{-4}\sim3\times10^{-5}$ mmHg. and that for various heater imputs was also measured. The maximum pumping speed of the large diffusion pump having a single oil jet was about 180 litre/sec for hydrogen at 1200 watts heater imput and that for duterium about 130 litre/sec at 800 watts. At the normal rating the theoretical ratio of the pumping speed of hydrogen to duterium is $\sqrt{2}$, but our experiments showed about 1. This discrepancy was considered to be due to the back diffusion of light gases.

Speed factors for hydrogen and duterium were calculated as 0.093 and 0.081 respectively which showed bad design of the diffusion pump.

We conceived also that the auxiliary diffusion pumps improved the decreasing pumping speed especially at high vacuum.

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9. Study on the Roller Chain Link Plate by the Photo-elastic Method

Yoshiaki Uemura, Munezo Takai and *Aiyuki Yukawa*

(K. Kimura Laboratory)

We fitted a pin (or bush) in each of the two holes of a roller chain link plate and observed it by the photo-elastic method, changing the radial pressure P at the hole and a tensile weight. As the test piece we used phenolite.

We found, under the condition above mentioned, that the relation between the stress at the hole and the tensile weight was similar to that which was shown by Haessler (Product Eng., May (1941), 263.) between the stress of a bolt and a tensile weight when a piece of rubber was inserted between two bolts. The relation led by him is as follows,

$$T=\{\beta/(\alpha+\beta)\}\ W+C_i \qquad (1)$$

where T is the stress of one of the bolts when tensile weight is W; α and β are the elongations of the bolt and the rubber respectively per unit tensile weight; C_i is the initial stress of the bolt. The relation between the maximum shearing stress around the hole and the tensile weight was almost linear (I). The mean tensile stress at the radial cross section passing through the center of the hole and the tensile weight showed a relation similar to eq. (I), but no linearity. This discrepancy seems to be due to a particular deformation process of the link plate.

Then we defined a quantity η, which we named "the coefficient of the share of the stress",

$$\eta_{\text{link plate}}=(T-T_0)/W, \qquad \eta_{\text{pin (bush)}}=(T'-T'_0)/W, \qquad (2)$$

where T is the mean tensile stress at the radial cross section under the tensile weight of W and T_0 is the value of T caused by fitting a pin when $W=0$. T' and T'_0 are the coressponding values to T and T_0 at the pin (or bush). From the condition of equilibrium, we obtain