DEVELOPMENT OF HIGH INTENSITY BEAM HANDLING SYSTEM AT KEK-PS NEW EXPERIMENTAL HALL

PART II, DEVELOPMENT OF THE QUICK DISCONNECT SYSTEM

Y.Kato, M.Minakawa, Y.Yamanoi, M.Ieiri, H.Ishii Y.Suzuki, M. Takasaki and K.H.Tanaka
Beam Channel Group, Physics Department,
KEK, National Laboratory for High Energy Physics,
Oho 1-1, Tsukuba-shi, Ibaraki-ken, 305 Japan

H.Kojima and K.Kaji
Ishikawajima-Harima Heavy Industries Co., Ltd.
1, Shin-Nakahara-Cho, Isogo-ku, Yokohama-Shi, 235, Japan

Introduction

The magnets of the new counter experimental hall will be placed in very high radiation field. The residual radiation level will be over 100 Rem/h at the magnet surface after one normal operation period (3 weeks). It is almost impossible to maintain the magnets in the beam tunnel. Therefor we need a quick disconnect system of the magnet from the beam line. The magnet maintenance will be carried out in a hot laboratory using remote manipulators in order to minimize radiation exposure to maintenance personnel.

The quick disconnect devices we developed are for cooling water, electric power and interlock signals for magnet itself, and vacuum flange and pumping port for beam duct. All the devices are assembled on an iron base plate with the magnet[1]. The base plate will be put on the floor table placed on the beam tunnel by a over head crane. We employed pivot fitting system between the base plate and the floor table for the position reproducibility of the magnets. The floor table is well aligned and fixed on the beam tunnel. The magnet comes back from the hot cell after the maintenance will be placed again on the floor table. The alignment clearance of the pivot fitting is better than 0.1mm. The electric power and interlock signals of the magnet are connected automatically between the base plate and the floor table. The cooling water and the pumping port are connected by using simple rotation motion supplied from the outside of the tunnel. The vacuum flanges at the both ends of the magnet beam duct are also combined by the same way. The details of the disconnect system are summarized in the following sections.

Electric power and interlock signals

The connectors of the electric power and interlock signals have the structure of quick disconnect without any external power, and are joined automatically by using magnet weight when the magnet is brought down on the floor table. Therefore these are set under the base plate of the magnet. We developed two types of the power connectors. One is the press conductor type and the other is the knife-switch type as shown in Fig 1 and 2. Maximum current/voltage is DC 3000A/200V in the both types. The contact surface of the connectors was designed to have the ability of self-cleaning. In order to resist for high level radioactivity, all the insulation parts of the connectors are made of ceramics. The performance of the connectors were tested up to 2500A/200V and no serious fault was found in both cases. The connector for the interlock signals is simple cannon type 24-pin coupling. All the insulation parts of the connectors are also replaced by ceramics. The connector itself was loosely bound in the connector mount placed below the magnet base plate in order to accept some axial umbalance between the female and male connectors.

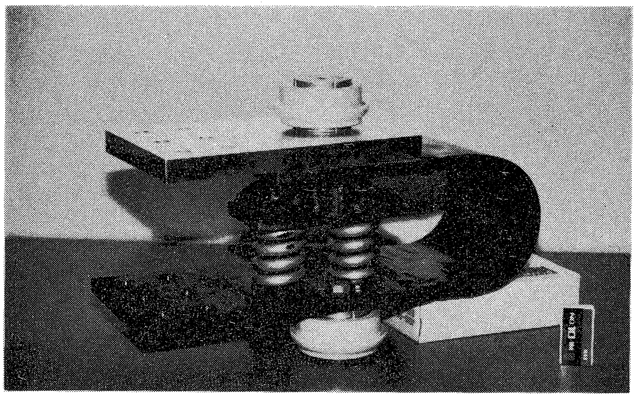

Fig.1, The press conductor type power connector.

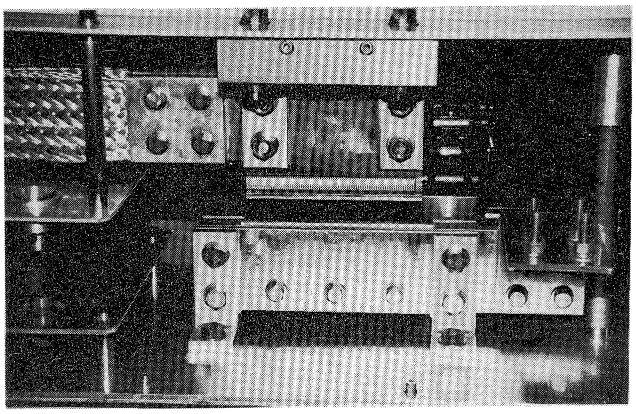

Fig.2, The knife-switch type power connector.

Cooling water and pumping port

The water joint we developed is the press-joint type using toggle-link structure as shown in Fig. 3. The connector size is 2 inches in diameter. The gasket used is metallic O-ring (Helicoflex, [2]) and attached on the magnet side so that the gasket is also brought to the hot sell and replaced easily. The pressure of cooling water employed in the new experimental hall is $20kg/cm^2$. The water connector was tested according to JIS 20kg flange standard. No leakage of water was found up to $50kg/cm^2$. The pumping port has the same structure as the water connector. The inner diameter of the port is, however, 1 inch. The helium leak test was carried out and less than 10^{-8} l.sec was found.

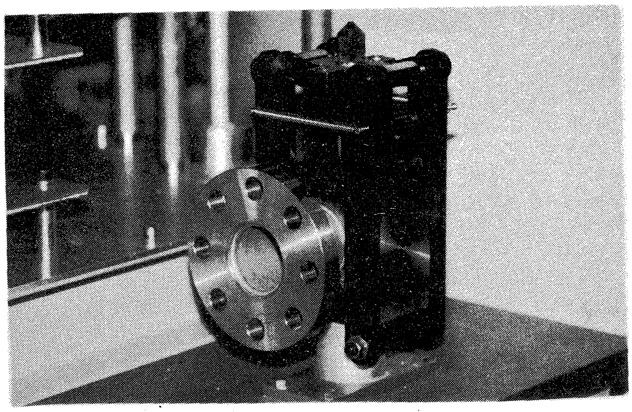

Fig.3, The press-joint type water connector using toggle-link structure.

Vacuum flange

Beam duct should be disconnected at the upstream and downstream ends of the magnet when the magnet is removed from the beam tunnel[3]. Therefore a disconnect device for the vacuum flange was developed as shown in Fig.4. Before the magnet is lifted, the flange disconnect device is released and the beam duct becomes 80mm shorter at both sides of the magnet with flange and with the disconnect device itself in order to clear the facing flanges. The vacuum flange we have been using is so called "KEK K-flange" which is designed by us for rubber O-ring and bound by V-band coupling. For the present development, the K-flange was re-designed to suit for metallic O-ring so that the flange binder became stainless-steel collar to increase the binding force. The new K-flange can accept the rubber O-ring and bound by V-band[4]. In other words, the new K-flange standard is lower compatible. The inorganic lubrication was employed in the flange disconnect device. The flange collar was made of "Devametal" which contains fine carbon powder in the brass body and ensures very low friction at the surface of the metal. The most parts which need the lubrication were made of "Devametal"[5]. MoS_2 was not used because of its long term instability.

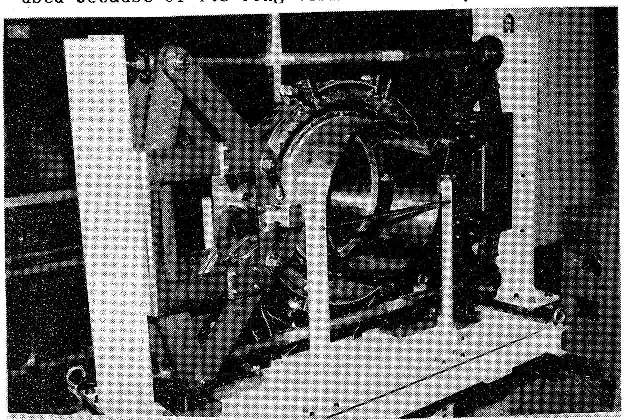

Fig.4, Vacuum flange disconnect system.

References

1. R.L.Keizer and M.Mottier, Radiation-Resistant Magnets, CERN 82-05, June 1982.
2. Helicoflex, the product of Usui Kokusai Sangyo, Co., Ltd.
3. M.Goujon and M.Mathieu, Reccord a vide telecommande, Note Technique SPS/SME/78-240, CERN.
4. V-band coupling, the product of Yokohama Aeroquip Co., Ltd.
5. Devametal, the product of Daido Metal Co., Ltd.