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INTRODUCTION

Residual radiation has become an important parameter in the design of high-energy accelerators. In the 200-GeV accelerator, at 7 h after beam turn-off, 5% of the circumference of the main ring is expected to have a residual radiation level of approximately 200 R/h at the most intense point. In this so-called "red" area, maintenance work would have to be done very quickly through master-slave manipulators operated by people working within shielded vehicles (Fig. 1). Work done with hand tools operated by commercial manipulators would take so long that the shielded vehicles could not provide adequate protection. Experience at hot laboratories has indicated that the operation time of remote handling is 10 to 20 times that of operation time with manual handling. But if the manipulator is used in conjunction with a special tool that does the more intricate and time-consuming operations, remote maintenance work can be performed very quickly. Thus, equipment designed with quick disconnects operated with special tools would be an asset to maintenance work in the 200-GeV accelerator.

In the "red" areas of the main ring, there are 25 gradient magnets; a rough estimate indicates that about 2 magnets per month would have to be replaced because of radiation damage to the coils' insulation. The magnet power and water-supply lines should therefore be designed to have quick disconnects (Fig. 2). In this note a proposed bus bar quick disconnect is described.

DESCRIPTION AND OPERATION OF THE BUS BAR QUICK DISCONNECT

The bus bar quick disconnect (Fig. 3) consists of a clamped
joint that is remotely operated with a special hydraulic compression tool. A contact pressure of about 2800 psi between the copper bus bars is obtained from a clamp made up of a high-strength bolt and a spring package consisting of four conical washers. Two pressure plates distribute the load on the bus bars. When the conical washers between the pressure plate and the head of the bolt are compressed, the clamp can be removed. To do these operations, the special tool (Fig. 3) is used.

The shielded manipulator vehicle is equipped with a hydraulic pump that can be remotely operated from inside the shielded cab. The compression tool, with its flexible hydraulic hose connected to the pump, is picked up with the manipulator load hook and placed over the quick-disconnect clamp. Because the grooves in the tool are tapered, gravity force alone is sufficient to align the tool. The pressure plate is then confined in the tool grooves, and a hydraulic cylinder compresses the washers. The clamp, together with the compression tool, is then removed and can be placed temporarily on a rack. In all these operations, the load hook only of the manipulator is used. With a skilled operator, the disconnection of the bus bar would take no longer than one minute. Similar operations were performed with mock-up tools in approximately 30 seconds.

Until accelerators can be designed with very little radiation hazard, the design of special remote equipment with quick disconnects should be strongly considered.

This work was done under the auspices of the U. S. Atomic Energy Commission.
REFERENCES


FIGURE CAPTIONS

Fig. 1. Bus Bar Quick Disconnect Operation from Shielded Maniipulator Vehicle Mock-Up.

Fig. 2. Gradient Magnet Mock-up with Operation of Bus Bar Quick Disconnect Using the Hydraulic Compression Tool.

Fig. 3. Bus Bar Quick Disconnect with Hydraulic Compression Tool.
Manipulator arm

Flexible hydraulic hose

Conical washers

Pressure plates

Bus bar

Alignment groove

Hydraulic cylinder

Self-aligning and self-locking nut

High-strength bolt

Magnet-coil terminal

Fig. 3
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