AN ACTIVE DEVICE TO PROTECT NUCLEAR PARTICLE ACCELERATORS FROM EARTHQUAKES

By

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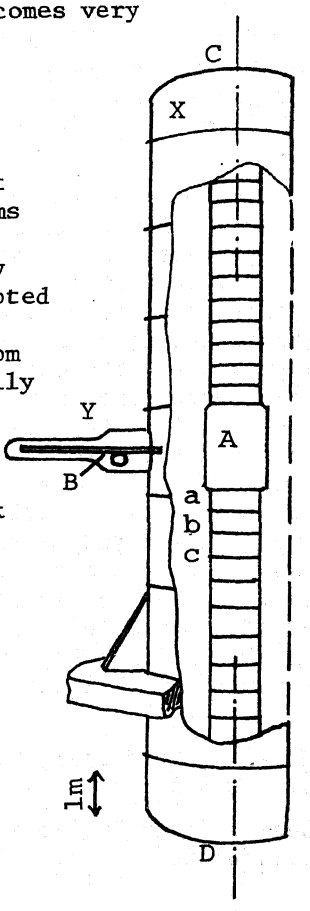
Modern electrostatic generators maintain high voltage electrostatic fields through which nuclear particles are accelerated. The terminal A of such an accelerator can be subjected to voltages in excess of 20 million volts and it becomes necessary to enclose it in a tank X pressurized with insulating SF_6 gas and support it with aluminum ceramic modules (a,b,c..) to avoid flashover and loss of charge. The ceramic column CAD which is attached to the tank at C and D is very strong in compression but it is vulnerable to lateral earthquake loadings which are not usually considered in the highly modularized design of the machine. Because increasing the lateral strength of the column was not deemed economically feasible, an electronically controlled active protection device was considered. One such device is now in operation at the Tsukuba University accelerator in Japan. Active devices have seldom been used in earthquake protection designs because they require maintenance and they are often too costly. For a multi-million dollars accelerator which has a maintenance program of its own, the active device becomes very desirable.

The active device which is used consists of four telescoping arms B which can be either fully retracted in their casings Y (the casings form an integral part of the tank wall) or fully extended and in contact with the terminal A. In the extended position, the arms provide strong lateral support for the terminal. A linear gear is attached to the arms which are driven by battery operated electric motors. This design was adopted because the entire mechanism has to be contained in an extremely severe environment (the pressure can vary from 80 psi of SF_6 gas to near vacuum). The arms are normally extended but they must be retracted when the accelerator is in use. If an earthquake occurs during an operational period, acceleration sensors activate the arms control mechanism and within one second these lock in on the terminal and the high voltage is dissipated through harmless discharges through the arms.



An analytical study of the protected column shows that the earthquake strength has been multiplied by a factor of close to 4. A comparable increase by strengthening the column modules would have been much more costly.

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