Liquid-Hydrogen/Nuclear-Radiation Resistant Seals

Materials have been investigated and procedures established for fabricating seals and gaskets used in nuclear-radiation/liquid-hydrogen environments. The seal and gasket used is similar to a previous one which employed fluorocarbon plastics and featured the controlled impregnation of woven glass reinforcements layered to provide a highly compressible cross section which maintained flange preload pressures at cryogenic temperatures.

Aromatic-heterocyclic polymers were substituted for the fluorocarbon plastics in order to provide nuclear radiation stability. These polymers do not have the flexibility or lubricity of most fluorocarbon materials; however, in combination with other materials, they are suitable for composite seals having nuclear radiation resistance and those properties necessary for performance in a liquid-hydrogen environment.

Tests on materials belonging to the heterocyclic group, i.e., the polyimides, polybenzimidazoles, and polyquinoxalines, revealed that the polyquinoxalines were most suited for processing into gaskets and seals. One significant achievement made during the research on the materials was the development of a moldable grade of polyquinoxaline, which proved to be the chief factor in the development of successful gaskets.

A plastic composite gasket was fabricated from the polyquinoxaline polymer utilizing a concept involving a resin-starved laminate consisting of alternating layers of woven glass fabric and polymer film. This design imparts a mechanical spring characteristic to the gasket, eliminating cold flow and resulting in essentially complete elastic recovery when the gasket is unloaded.

Encapsulating techniques employing the polyquinoxaline polymer rendered the gasket impervious to liquid hydrogen. The gaskets were tested before and after nuclear radiation up to 10^{10} ergs/gram (carbon) gamma. Load/deflection and leakage tests were performed over a temperature range of 20 through 533 K. Performance was satisfactory for all conditions tested, and specimens showed no visual change or degradation after exposure to irradiation dosages of 10^{11} ergs/gram (carbon) gamma and 10^{17} nvt fast neutrons.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

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