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Special Treatment Reduces Helium Permeation of Glass in Vacuum Systems

The problem:

Permeation of helium through glass has become an important consideration in the design and construction of ultrahigh vacuum equipment. The helium atom is sufficiently small to penetrate the silicon dioxide lattice of a glass vessel used in a high vacuum system, thereby limiting the minimum pressure obtainable.

The solution:

The internal surfaces of the glass component of the vacuum system are exposed to cesium in gaseous form derived from decomposition of cesium nitrate through heating.

How it's done:

The cesium nitrate is placed in a glass vessel connected by tubing to the primary pressure vessel to be treated. Pressure in both vessels is lowered by means of a vacuum pump. After a high vacuum has been obtained, heat is applied to the vessel containing the cesium nitrate until its decomposition temperature level has been reached at which point cesium gas is produced. Due to the extremely low pressure, the cesium atoms have high mobility and readily travel throughout the system. Several minutes of exposure of the internal surfaces of the glass vessel are sufficient to complete the treatment.

Notes:

1. The vessel containing the cesium nitrate must be raised to a temperature above 414°C, the melting point of cesium nitrate. A vessel of quartz glass or special laboratory glass is used to prevent distortion due to the pressure differential across its wall.
2. This treatment would be useful during fabrication of dewar vacuum glass jackets in order to increase their efficiency.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457 (f)) to Midwest Research Institute, 50th and Cherry Streets, Kansas City, Missouri 64110.

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Category 02