



⊕ Rapid-Chill Cryogenic Coaxial Direct-Acting Solenoid Valve

Marshall Space Flight Center, Alabama

A commercially available cryogenic direct-acting solenoid valve has been modified to incorporate a rapid-chill feature. In the original application for which this feature was devised, there is a requirement to ensure that at all times, the valve outlet flow consists entirely or mostly of liquid; that is, there is a requirement to minimize vaporization of cryogenic liquid flowing through the valve. This translates to a requirement to chill interior valve surfaces in contact with the flowing liquid.

The net effect of the modifications is to divert some of the cryogenic liquid to the task of cooling the remainder of the cryogenic liquid that flows to the outlet. Among the modifications are the addition of several holes and a gallery into a valve-seat retainer and the addition of a narrow vent passage from the gallery to the atmosphere. Even when the valve is closed, cryogenic liquid flows from upstream of the valve seat, through the holes, and into the gallery, where it circulates around the valve outlet and may be

partly vaporized before being vented. As a result, the outlet and nearby valve components are maintained at a temperature close to that of the upstream cryogenic liquid. The rate of flow of cryogenic liquid diverted to the task of cooling is limited by the small diameter of the vent passage.

This work was done by James Richard of Marshall Space Flight Center, Jim Castor of Castor Engineering, and Richard Sheller of Sverdrup Technology, Inc. Further information is contained in a TSP (see page 1). MFS-32110-1

⊕ Variable-Tension-Cord Suspension/Vibration-Isolation System

Cord tensions are adjusted to optimize vibration-isolation properties.

Lyndon B. Johnson Space Center, Houston, Texas

A system for mechanical suspension and vibration isolation of a machine or instrument is based on the use of Kevlar (or equivalent aromatic polyamide) cord held in variable tension between the machine or instrument and a surrounding frame. The basic concept of such a tensioned-cord suspension system (including one in which the cords are made of aromatic polyamide fibers) is not new by itself; what is new here is the additional provision for adjusting the tension during operation to optimize vibration-isolation properties.

In the original application for which

this system was conceived, the objective is to suspend a reciprocating cryocooler aboard a space shuttle and to prevent both (1) transmission of launch vibrations to the cryocooler and (2) transmission of vibrations from the cryocooler to samples in a chamber cooled by the cryocooler. The basic mechanical principle of this system can also be expected to be applicable to a variety of other systems in which there are requirements for cord suspension and vibration isolation.

The reciprocating cryocooler of the original application is a generally axisymmetric object, and the surrounding

frame is a generally axisymmetric object with windows (see figure). Two cords are threaded into a spokelike pattern between attachment rings on the cryocooler, holes in the cage, and cord-tension-adjusting assemblies. Initially, the cord tensions are adjusted to at least the level necessary to suspend the cryocooler against gravitation. Accelerometers for measuring vibrations are mounted (1) on the cold tip of the cryocooler and (2) adjacent to the cage, on a structure that supports the cage. During operation, a technician observes the accelerometer outputs on an oscillo-



The Suspension/Vibration-Isolation System of the original application is depicted here at three successive stages of assembly.

scope while manually adjusting the cord tensions in an effort to minimize the amount of vibration transmitted to and/or from the cryocooler.

A contemplated future version of the system would include a microprocessor-based control subsystem that would include cord-tension actuators. This control subsystem would continually adjust the cord tension

in response to accelerometer feedback to optimize vibration-isolation properties as required for various operating conditions. The control system could also adjust cord tensions (including setting the two cords to different tensions) to suppress resonances. Other future enhancements could include optimizing the cord material, thickness, and braid; optimizing the spoke patterns;

and adding longitudinal cords for applications in which longitudinal stiffness and vibration suppression are required.

*This work was done by Mark L. Ville-marette, Joshua Boston, Judith Rinks, Pat Felice, Tim Stein, and Patrick Payne of **Johnson Space Center**. Further information is contained in a TSP (see page 1).
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