Books & Reports

Improved Traps for Removing Gases From Coolant Liquids

Two documents discuss improvements in traps for removing noncondensable gases (e.g., air) from heat-transfer liquids (e.g., water) in spacecraft cooling systems. Noncondensable gases must be removed because they can interfere with operation. A typical trap includes a cylindrical hydrophobic membrane inside a cylindrical hydrophilic membrane, all surrounded by an outer cylindrical impermeable shell. The input mixture of gas bubbles and liquid flows into the annular volume between the membranes. Bubbles pass into the central hollow of the hydrophobic membrane and are vented. The liquid flows outward through the hydrophilic membrane and is recirculated. The proposed improvements include the following:

1. The outer membrane would be made of a more hydrophilic, commercially available material so that membrane pores could be made smaller without increasing the pressure drop. Decreasing the pore size would increase the bubble pressure, thereby increasing the degree of retention of bubbles in the trap.
2. Multiple hydrophobic membranes would be used to increase venting area at the downstream end, where bubbles tend to collect.
3. Upstream of the venting area, the hydrophobic membranes would be coated with a dense polymer to reduce evaporation of the coolant liquid.

This work was done by John Holladay of **Marshall Space Flight Center** *and Stephen Ritchie of the University of Alabama. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. MFS-32037-1*

Lunar Constellation of Frozen Elliptical Inclined Orbits

A document discusses the design of orbits of spacecraft for relaying communications between Earth stations and robotic and human explorers in craters in one of the polar regions on the Moon. In simplest terms, the basic problem is to design a constellation of orbits to provide continuous and preferably redundant communication coverage of one of the poles with a minimal number of spacecraft and little or no controlled maneuvering of the spacecraft to maintain the orbits. The design method involves the use of analytical techniques for initial selection of orbits, followed by a numerical procedure for tuning the coverage of the constellation to obtain a design. In an example application, the method leads to a constellation of three spacecraft having elliptical, inclined orbits, the apoapsides of which would remain in the hemisphere (North or South) containing the pole of interest. The orbits would be stable and would maintain the required spacecraft formation for at least 10 years, without need for controlled maneuvering if gravitation is the only force considered to affect the orbits. A small amount of controlled maneuvering would be needed to counteract effects of solar-radiation pressure and other perturbations.

This work was done by Todd Ely and Gary Noreen of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP* *(see page 1).* *NPO-40992*