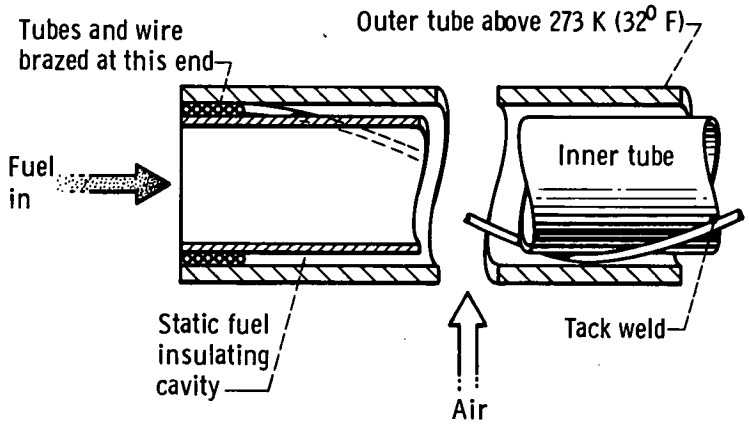
NASA TECH BRIEF

Lewis Research Center

FLUID INSULATION TO PREVENT ICE FORMATION IN HEAT EXCHANGERS



The Problem:

Heat exchangers transferring heat from moist air to liquid hydrogen were subject to ice formation which blocked the air side passages.

The Solution:

Insulate the heat transfer surfaces to maintain the air side surface temperature above freezing by using double wall tubes with the annular space between the tubes filled with static liquid hydrogen. The low thermal conductivity of the static liquid hydrogen provides the necessary thermal resistance.

How It's Done:

The heat exchanger is made up of concentric inner and outer tubes as shown in the figure. The presence of a static low conductivity fluid (liquid hydrogen) in the space between the tubes creates a high temperature gradient between the tubes and results in an outer tube temperature closer to that of the flowing air, thereby preventing the icing. A wire wound around the inner tube in a helical path and held in place by tack welds maintains spacing between the tubes. The outer tube is slipped over the wire-wound inner tube. One end of the annular space between tubes is provided with means for filling and draining the static fluids; the opposite end is brazed closed to securely retain the inner tube and wire.

This double wall tube configuration particularly facilitates fabrication of curved sections. The inner and outer tubes are bent separately using form blocks before being wire wound and assembled. The use of solid insulating materials between the concentric tubes was not feasible because it is difficult to install between the small tubes and would be damaged by brazing or welding the tube ends to the headers of the heat exchanger. Gas or vacuum jacket insulation was difficult to seal and leakage could not be detected.

Notes:

1. This arrangement has been successfully applied to the design and manufacture of an air-to-hydrogen heat exchanger using jet engine compressor bleed air to heat liquid hydrogen fuel. No icing problems were encountered.
2. This innovation should be useful for other applications where it is desirable to maintain the surface temperature above or below a specified value to avoid undesirable property effects of the fluid, such as freezing, congealing, gumming and coking.

(continued overleaf)

3. No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B73-10028

Patent Status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

NASA Patent Counsel
Mail Stop 500-113
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135

Source: George A. Coffinberry
General Electric Co.
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