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NASA TECH BRIEF

Goddard Space Flight Center

Monel-Shot and Screen Regenerators

Regenerators are thermal-energy storage devices used to transfer energy to and from the working fluid of several devices. They are frequently used in cryogenic engines or refrigerators. A high-temperature fluid flows through the regenerator and gives up a major portion of its heat. The fluid emerges from the regenerator at a substantially lower temperature. When the flow direction is reversed, the fluid passes through the regenerator to pick up heat and then reemerges at the high temperature.

A certain amount of heat loss occurs during this cycle. The loss, however, can be reduced by choosing a regenerator-matrix material with a high energy-storage capacity and by shaping and sizing the material for efficiency.

Monel has been found to be an ideal material for the matrix of regenerators operating in the temperature range of 325 K to 50 K. The two best shapes are as spheres or as wire mesh; each shape has its own advantages.

With packed spheres, the void fraction is lower (about 0.38). Thus, a greater mass of matrix material can be packed in the same volume. This increases the heat transfer and increases the pressure drop per unit length of regenerator. Screens have a comparatively low resistance to flow, but their void fraction is higher. The reduced flow resistance decreases the pressure drop through the matrix, which decreases the driving force on the fluid and this decreases heat loss.

For a given size of regenerator, spherical shot are preferable for low-temperature operation. At low temperatures, the specific heat of metals is low, and the increased mass of matrix material is necessary to get a large enough total-heat capout. At high temperatures, the mesh would be superior by virtue of its lower flow resistance.

Notes:

1. A detailed study has been made of the design, development, and fabrication of a miniature Vuilleumier Cryogenic using Monel regenerators.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Code 207.1
   Greenbelt, Maryland 20771
   Reference: TSP73-10462

Patent status:

NASA has decided not to apply for a patent.

Source: Calvin W. Browning of
The Garrett Corp.
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