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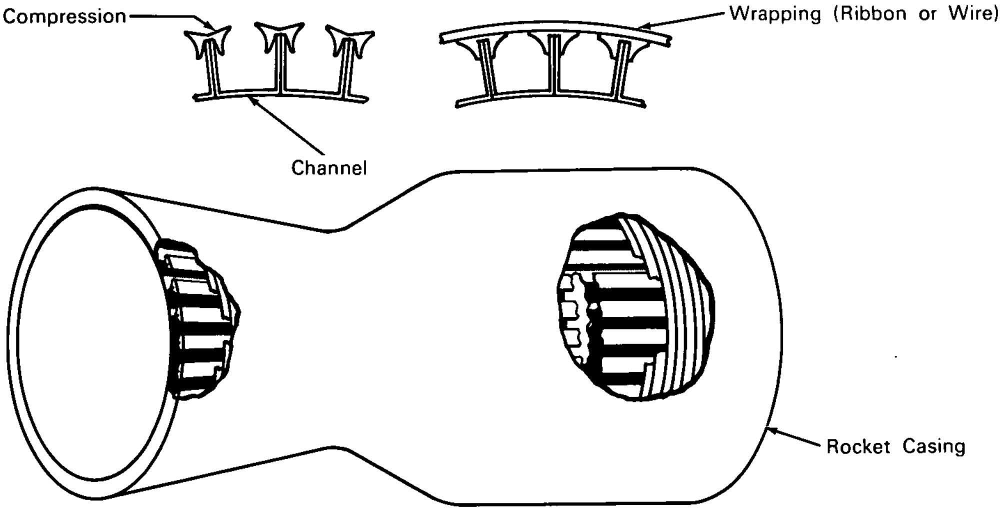
NASA TECH BRIEF

New Method Used to Fabricate Light-Weight Heat Exchanger for Rocket Motor



The problem: Increasing the strength and heat-transfer characteristics of lightweight rocket motor casings that employ channels for regenerative cooling.

The solution: A special type of capstrip having a deep groove in it to straddle the edges of the metal channels. Design of the capstrip causes a firm joint to be made between the channels that form the rocket casing wall.

How it's done: Rockets that employ regenerative cooling generally have a casing wall made of a series of U-shaped metal channels joined at their sidewalls by brazing. The channels are bent to the desired curve before joining. The channels, when closed, allow liquid propellent to circulate and cool the rocket motor chamber. Thin metal channels needed for optimum heat transfer have limited strength because the typical butt-braze joint limits the stress in the channel to a value much lower than the yield strength.

This invention calls for a capstrip which is placed along the joined outer edges of the channels. In cross section the strip resembles a split T, with the vertical element of the T deeply grooved. The horizontal cross-bar of the T curves up. When the capstrip is pressed into place the cross bar is flattened so that the two legs of the vertical element grip the channel edges tightly. The wall structure is completed by wrapping ribbon or wire around the channels at right angles to the capstrip. Brazing alloy is provided between the contact faces of the channels and on the inner surface of the ribbon wrapping. Heating to the

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proper brazing temperature completes the rocket wall chamber. It may be desirable to electroplate the capstrip with copper or a brazing alloy 0.0002 to 0.001 inches thick before assembly in order to guarantee proper placement of brazing.

Several advantages have been found with this construction: Improved cooling with thin-wall channels and an extension of the upper limit of the expansion ratio considerably above other fabrication processes. The capstrip also provides sufficient braze-shear-area attachment between the channels. The design gives high strength per unit of weight since—in addition to increased brazing area—the skin formed by the outer wrapping enables the materials of the channels to be used efficiently at high working stress levels. Lighter weight metal channels will thus give strength equivalent to heavy channels because the design does not depend on the butt brazing of the channel edges to the ribbon wrapping.

Note:

Industrial applications of this invention would include heat exchangers and heat transfer equipment. It would be most suitable where high strength, light weight and heat-transfer capability were all required.

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