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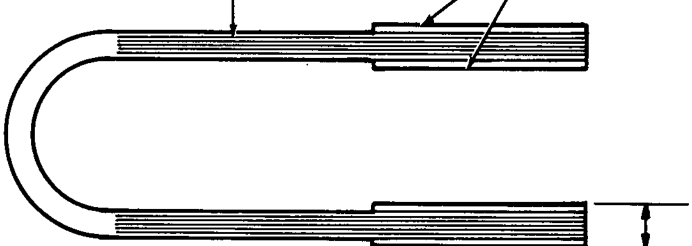
NASA TECH BRIEF
Marshall Space Flight Center

Flexible Thermal Device



The problem:

Existing expansion-joint/vibration-isolator methods such as wound coils, standard springs, nonmetallic vibration isolators, and slip joints are ineffective heat transfer devices because they lack sufficient cross-sectional area, do not meet minimum length requirements, have low thermal conductivity, or have discontinuous heat paths.

The solution:

Fabricate a device that consists of multiple layers of metal foil that have been tailored to meet a specific requirement.

How it's done:

The device consists of multiple layers of metal foil that have been tailored to meet a specific requirement. At the heat input and output ends of the device, the foil layers are compressed to a dimension less than their nominal stacked thickness and held in this position either by welding or mechanical fasteners. This compression removes air from between foil layers, removes surface irregularities in individual foil elements, and thus insures optimum heat transfer. Given the geometrical envelope available and the quantity of heat to be transferred, the number, thickness, and material of the foil elements may be determined to achieve the desired flexibility. For example, given a quantity of heat (Q) to transfer within a specified temperature drop (ΔT) the following relationship holds $Q = KA\Delta T/L$ where K is the thermal conductivity of the foil material, A is the cross sectional area of the stacked foil layers, and L is the average length of a single foil element. For optimum heat transfer and availability in foil form, a material such as aluminum with its high thermal conductivity is usually desirable. The length and cross sectional area may now be determined to satisfy envelope and heat transfer requirements.

Having the required geometry, the desired flexibility (spring constant) may be achieved by selecting the proper number and thickness of individual elements. The thickness of each element need not be the same. In fact, it may

(continued overleaf)

be desirable from operational considerations to have one or more elements made from thin gauge sheet stock. The sheet stock element may be designed to flex through the desired travel at a stress lower than its yield strength to assure elastic recovery to its original configuration. The device may also be used as a low spring constant vibration isolator and as a suppression device for vibration induced noise.

Notes:

1. Information concerning this innovation may be of interest to machine and structural designers.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B72-10612

Patent status:

NASA has decided not to apply for a patent.

Source: S. D. Wallace, and D. H. Elliott of
McDonnell Douglas Corp.
under contract to
Marshall Space Flight Center
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