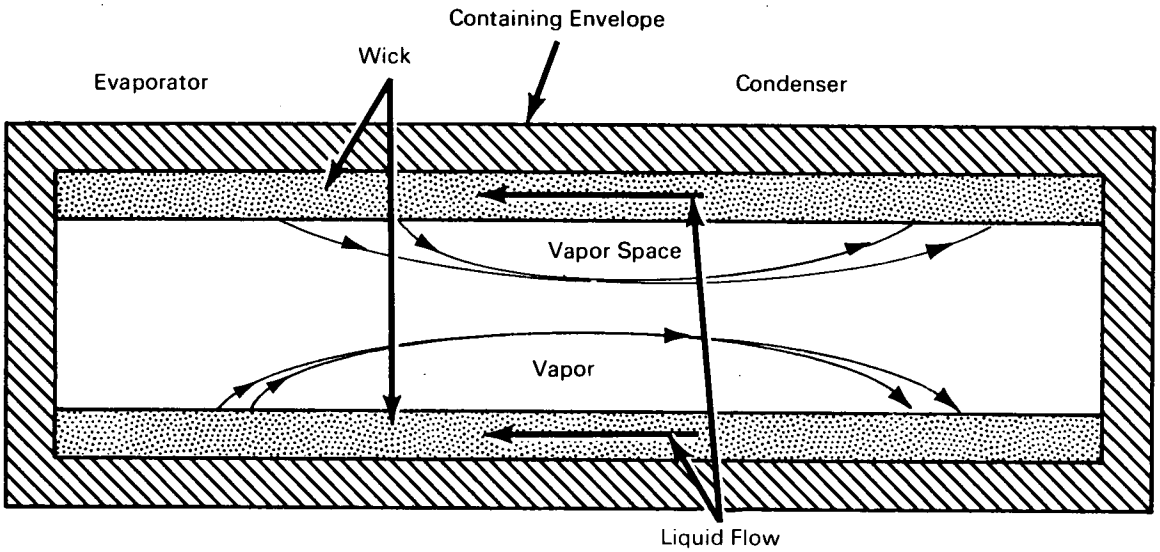
September 1970

Brief 70-10106

NASA TECH BRIEF

Water-Filled Heat Pipe Useful at Moderate Temperatures



Cross-Sectional View of a Heat Pipe

A heat pipe is a self-contained device that achieves very high thermal conductance by means of two-phase fluid flow. As shown in the illustration, the fluid evaporates near one end of the pipe and recondenses near the other, thus transferring heat from the evaporator to the condenser. The vapor flows naturally through the central space toward the condenser, while the condensate returns to the evaporator by capillary flow through a porous material known as the wick.

The heat pipe has been applied in the primary heat exchanger for nuclear power plants, as a heat sink for high-power electronic devices, and in a closed-cycle heat rejection mechanism for cryogenic storage tanks. Because of its construction, it may serve simultaneously as a heat transfer device and as a structural member, frequently resulting in lighter weight designs than are possible with more conventional heat transfer techniques.

A theoretical and experimental study of the water-filled heat pipe has verified its usefulness as a heat transfer medium in the temperature range from 200° to 350°F. Some of the conclusions of the study are as follows: (1) existing heat pipe equations can be used with confidence to predict the heat transfer efficiency of water-filled heat pipes within the stated temperature range; (2) the absence of gravitational forces does not affect the performance of heat pipes; (3) thermal conductivity of nonmetal wicks is too low for use in heat pipes designed to transfer larger heat loads; (4) the wick material should be firmly bonded to the inner wall of the heat pipe container to decrease thermal resistance; (5) the heat load capacity of a heat pipe

(continued overleaf)

is determined by capillary pumping limitations and by the onset of film boiling, but in the pipes studied, the capillary-pumping limitation was more crucial; and (6) the startup of a frozen heat pipe, even at low power, may result in burnout.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-TM-X-53849 (N69-38853), An Experimental and Analytical Study of Water Heat Pipes for Moderate Temperature Ranges

Patent status:

No patent action is contemplated by NASA.

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