A lightweight, active thermal control mechanism for spacecraft use comprised of woven or unwoven cross-layered yarns where one set of yarns are composed of flexible electrically conductive metal fibers which are capable of being resistance-heated by the application of voltage and another set of yarns which are electrically non-conductive and flexible. The non-conductive yarns provide mechanical strength and preclude the passage of electrical current between metal yarns by virtue of the spacing between them. A lightweight, electrically non-conductive film is bonded to the cross-layered yarns to protect the metal yarns from the elements (minimize electrical shorts from moisture, e.g., rain), provide additional strength to the fabric and to prevent the conductive loss of heat in non-vacuum applications. The non-conductive film is metalized on its obverse side to provide a more uniform heat load distribution.
LIGHTWEIGHT ELECTRICALLY-POWERED FLEXIBLE THERMAL LAMINATE

ORIGIN OF THE INVENTION

The invention described herein was made by employees of the United States Government and may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon for.

FIELD OF THE INVENTION

This invention relates to thermal control mechanism and more particularly, to a lightweight laminate structure to cover any space component, in a vacuum or non-vacuum environment, and to provide localized controlled heating. The structure may be used in non-space applications where weight, bulk, or stiffness are critical.

A prime consideration and difficulty in space equipment and accessories is weight and weight per available space. A spacecraft containing liquid oxygen and hydrogen is cold enough on its external surface so that ice can form under given meteorological conditions. Ice so formed can cascade during a launch and impinge upon space applications where weight, bulk, or stiffness are critical.

The failure of insulation could preclude a safe reentry of the spacecraft. Presumably damage the insulation. The failure of insulation generally are heavy, stiff and bulky. One of the problems of reducing weight by reducing size is that the fabric strength rapidly falls off.

SUMMARY OF THE PRESENT INVENTION

In the present invention, the thermal control mechanism consists of lightweight woven or non-woven sets of yarns in which one set of the yarns is composed of flexible, electrically conductive metal fibers capable of being resistance heated by the application of voltage. The remaining set of yarns is electrically non-conductive and is used to provide additional mechanical strength as well as to preclude passage of electrical current between the metal yarns. The non-conductive yarns assure that minimum spacing between metal yarns is maintained. The yarns are integrated with a lightweight plastic, electrically non-conductive film which is bonded to the yarns. The film performs the function of providing additional strength and also prevents convective loss of heat in a non-vacuum application. The film is metallized on its obverse side to provide for a more uniform heat load distribution. The multifilament yarns are composed of continuous filament fibers which are fine and flexible.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in plan section of a matrix of metal and electrically non-conductive yarns woven and bonded to a base film in accordance with the present invention; and

FIG. 2 is a cross-section taken along line 2-2 of FIG. 1.

DESCRIPTION OF THE INVENTION

Referring now to FIGS. 1 and 2 of the drawings, a matrix 10 is formed by interweaving filling yarns or