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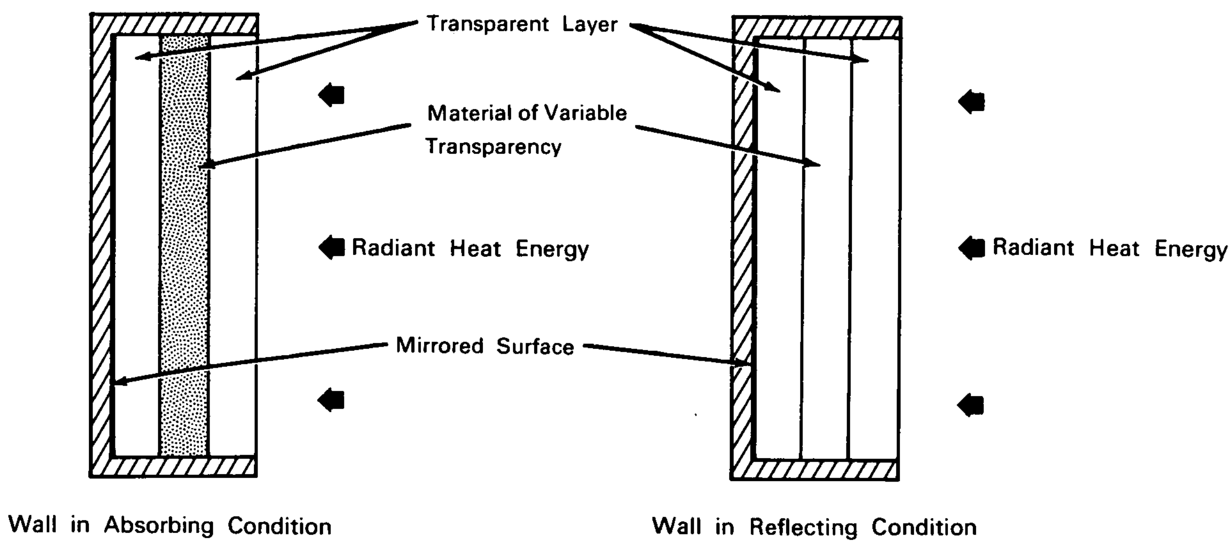
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

Variable-Transparency Wall Regulates Temperatures of Structures



The problem: To design a simple, inexpensive wall that, on exposure to a source of radiant heat energy, would automatically stay at a predetermined temperature.

The solution: A composite wall, one section of which contains a material that absorbs thermal radiation when the material is at a temperature below its melting point and is transparent to the radiant energy when the material is at a temperature above its melting point.

How it's done: The composite wall consists of a number of sections or layers, as shown in the diagram. The front layer is a window of transparent material, such as glass, fused quartz, or plastic. Behind the front layer is a second layer of material (e.g., one of the paraffins) that absorbs most of the incident radiant heat energy when the material is solid (below its melting point) and transmits most of the radiant energy when the material is heated above its melting point. This material is therefore relatively opaque to thermal radiation in the solid state and transparent to it in the molten state. Behind this second layer is another transparent layer, which may be composed of the same material as the front layer. On the back layer of the composite wall is a mirror coating, such as silver or vapor-deposited aluminum.

When the paraffin material is solid (as indicated in the diagram), thermal radiation passing through the transparent front layer will be largely absorbed by the paraffin. As a result, the temperature of the paraffin will rise. At the same time, the temperature of the other layers of the composite wall will rise by conduction of the heat inside the wall structure. When, by this process of heat absorption, the paraffin reaches its

(continued overleaf)

melting point, it will liquefy and become transparent to the thermal radiation. The incident thermal radiation will now pass through to the reflecting layer and be reflected back through the front layer. In this reflecting condition of the wall, little of the thermal radiation is absorbed, and its temperature ceases to increase. Should the temperature of the wall then tend to decrease, the paraffin will begin to solidify and again absorb heat from the thermal radiation, to repeat the cycle. In this way, the composite wall automatically maintains a temperature near the melting point of the paraffin.

Notes:

1. A wide range of temperatures can be obtained by choosing different members of the paraffin series of hydrocarbons for the wall of variable transparency, e.g., n-undecane, m.p. —25.6°C; n-heptadecane, m.p. 22.0°C; or n-tetracosane, m.p. 51.1°C.
2. The composite wall can be made in a variety of designs. For example, the mirror coating may be omitted from the wall, in which case the radiation will pass through the wall (when the paraffin is melted) instead of being reflected. Instead of the paraffins, other combinations of materials may be used, e.g.,(a.)wax or paraffin beads dispersed in a transparent plastic; heat from the radiant energy will melt the opaque beads without melting the plastic matrix, the result being a uniformly transparent material; (b.) a solid polymer, such as "treated polyethylene" that is opaque at low temperatures but that becomes crystal clear at higher temperatures, even though the polymer is still solid.
3. Possible applications include maintaining desired temperatures in greenhouses and other buildings.
4. For further information about this innovation inquiries may be directed to:
   Technology Utilization Officer
   Langley Research Center
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   Reference: B63-10528

Patent status: NASA encourages the immediate commercial use of this innovation. Inquiries about obtaining rights for its commercial use may be made to NASA Headquarters, Washington, D.C. 20546.

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