



(12) **United States Patent**
Malach

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(54) **PHASE CHANGE FORMULATION**

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(21) Appl. No.: **09/523,570**

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Related U.S. Application Data

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1999.

(51) **Int. Cl.**⁷ **C09K 5/00**

(52) **U.S. Cl.** **252/70; 252/71; 252/73;**
252/74; 165/10; 165/104.19; 165/104.21

(58) **Field of Search** **252/70, 71, 73,**
252/74; 165/104.19, 10, 104.21

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(57) **ABSTRACT**

A thermal packaging system using a single phase change material (PCM) part in liquid and part in solid form to confine the temperature of the product within a predetermined range. The temperature ranges are determined by the selection of PCM formulation. The phase change materials selected have high latent heats of fusion and maintain relatively constant temperatures as they change phase. This permits light weight packaging with the maintenance of temperatures in narrow, preselected ranges over extended periods of time. A phase change formulation that can be adjusted to freeze at temperatures from +40° C. to below -30° C. is disclosed, comprising butanediol, selected percentages of distilled water, and nucleating agents. The phase change occurs over a narrow temperature range making this an ideal temperature control media. Nucleating or other agents are included to narrow the temperature range over which the phase change occurs.

20 Claims, 15 Drawing Sheets

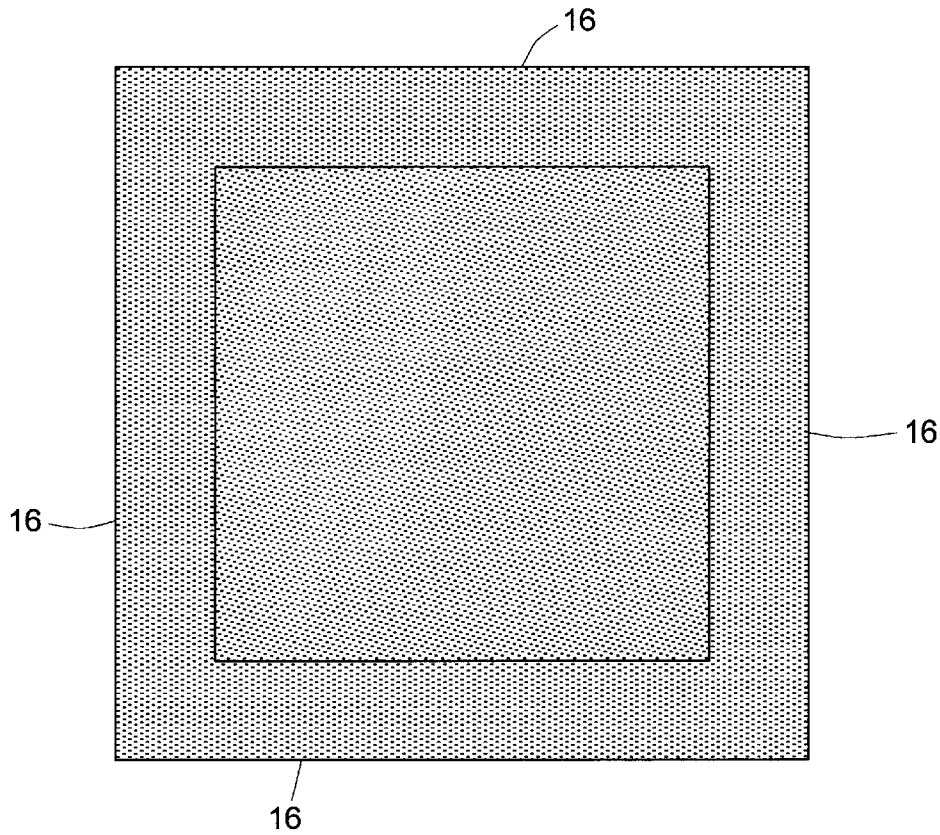


FIG. 1

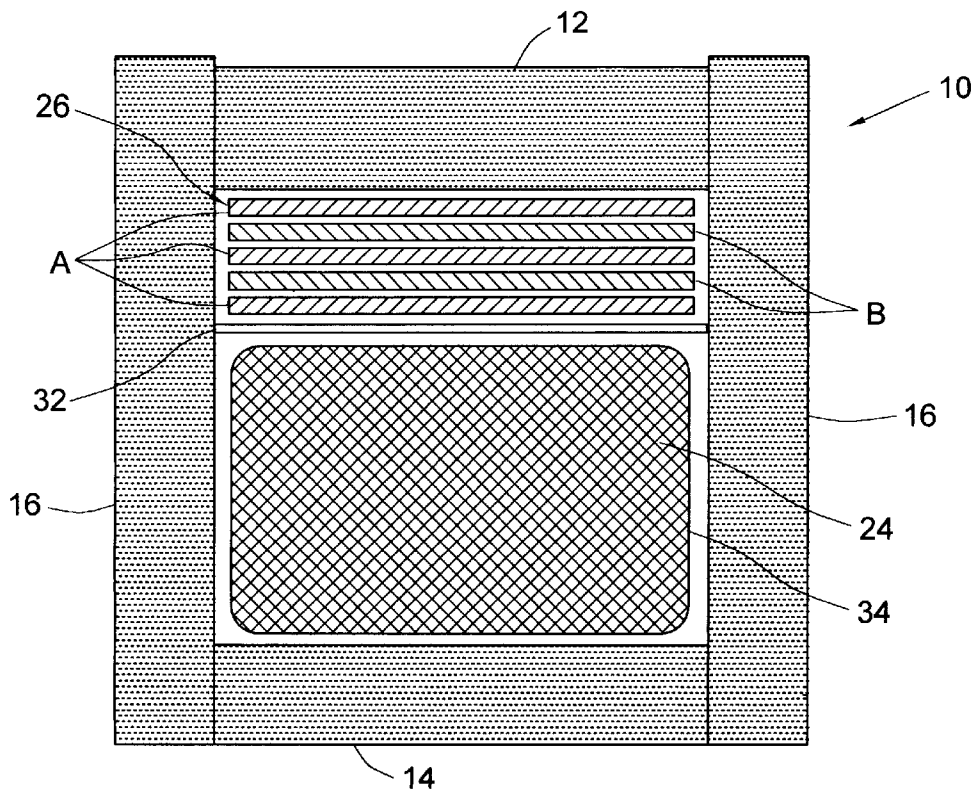


FIG. 2

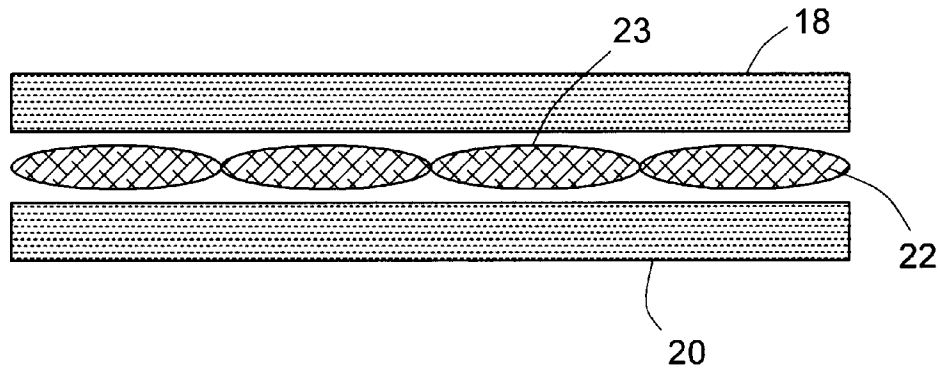


FIG. 3

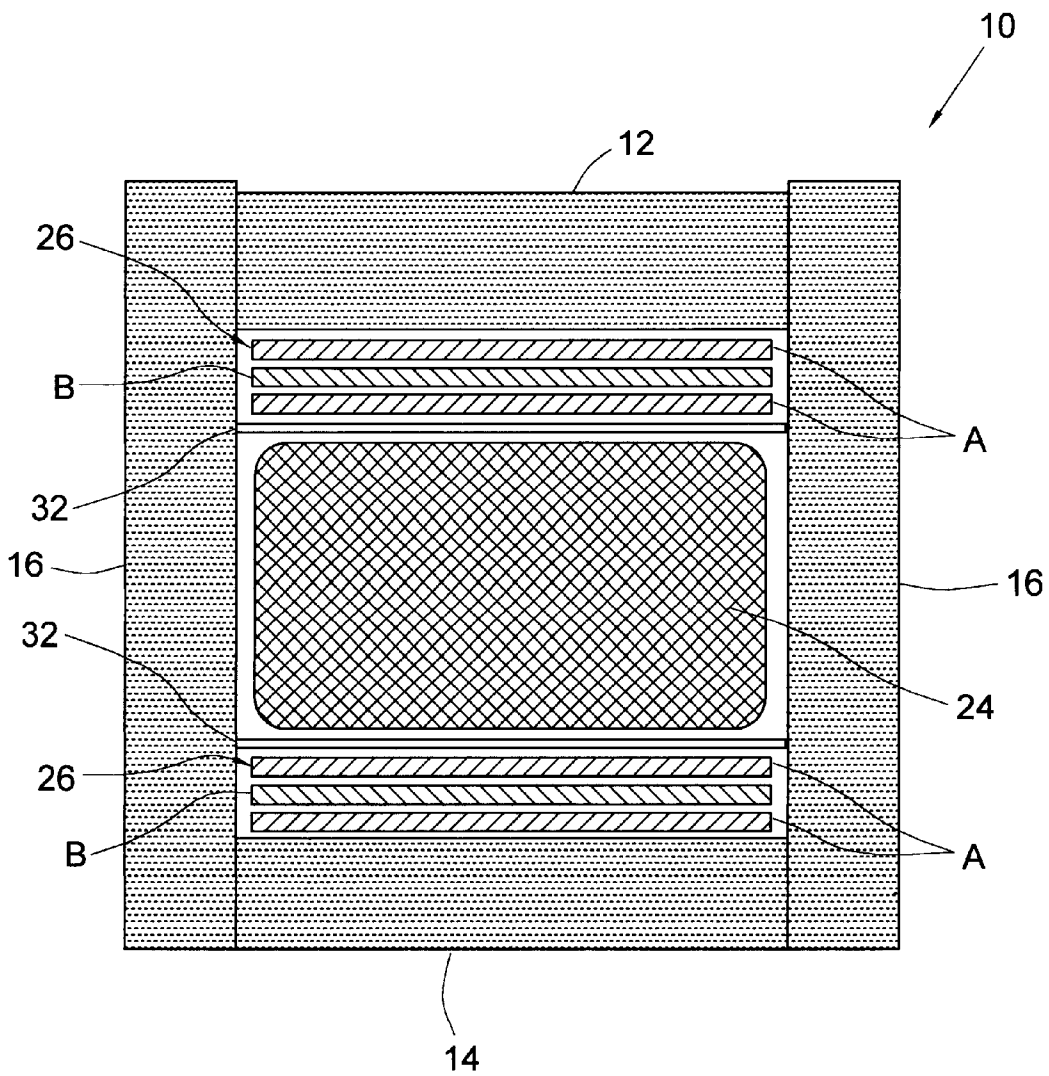


FIG. 4

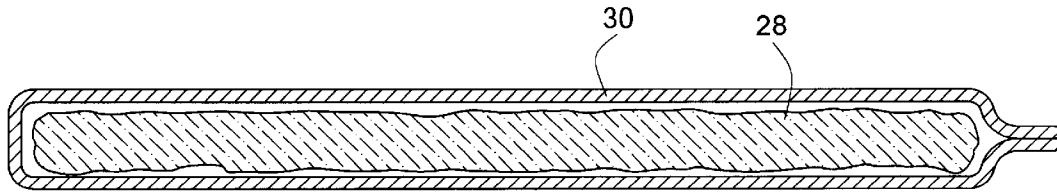


FIG. 5

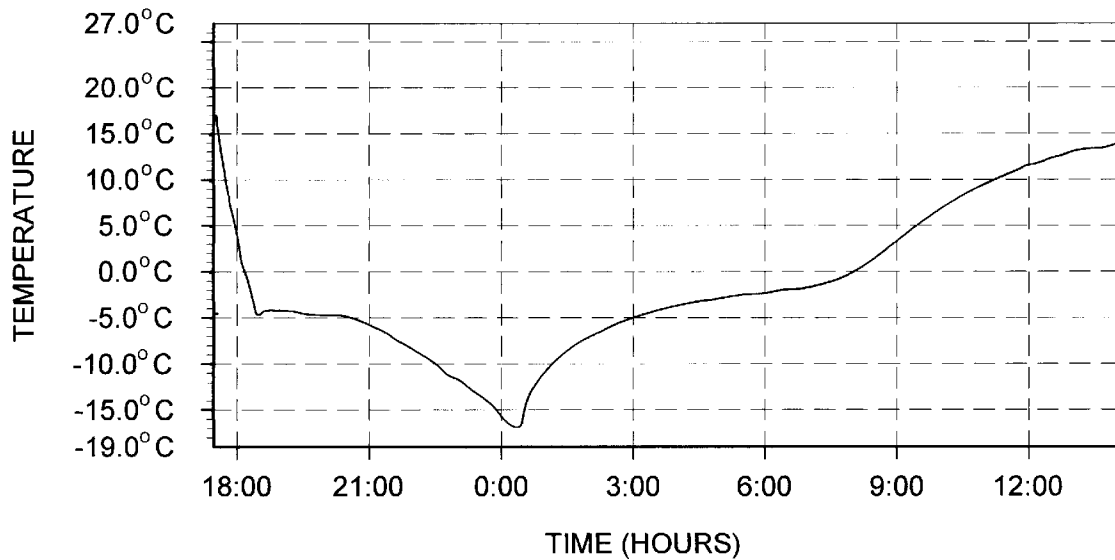


FIG. 6

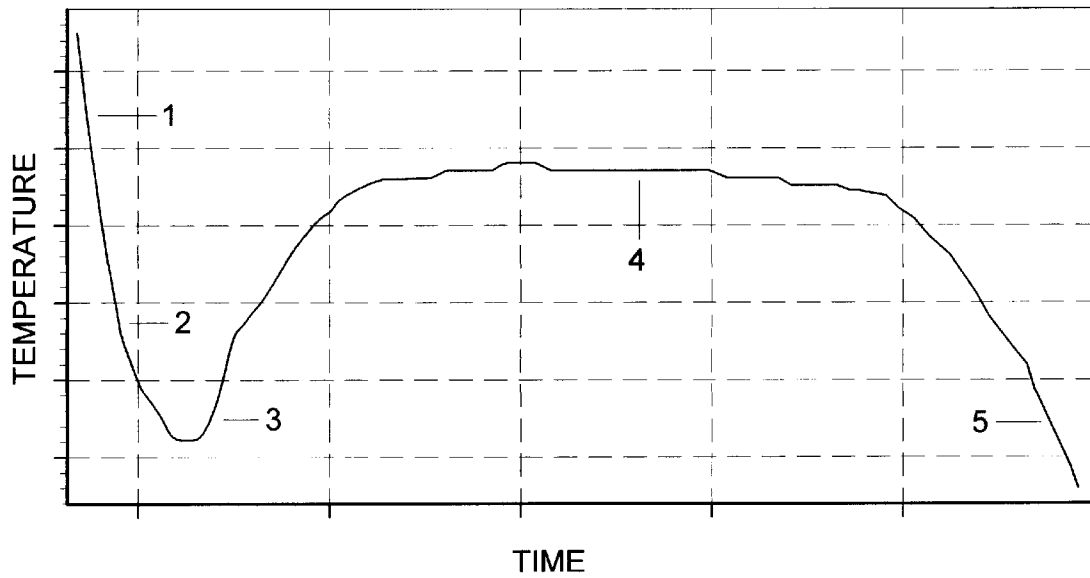


FIG. 7

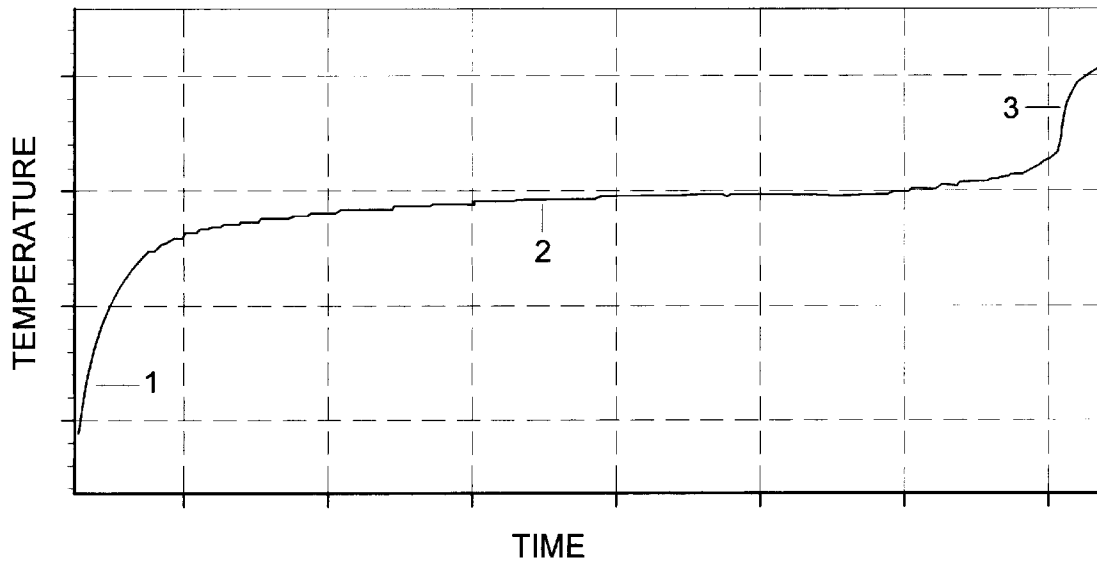


FIG. 8

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